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Economy in the Engine Room

Those who have followed the "Economy Talks," by "Old Scotch," published in recent issues of this journal, cannot fail to realize that the market to-day is well supplied with special appliances which have an important bearing on the economy of steamship operation. It has been shown how important are many seemingly insignificant additions to an engine-room equipment, resulting in most important savings, which mean added profits to the ship owner and which should mean increased income for the engineer. This fact has been brought out in many of the letters contributed to our columns by engineers, and we hope that many others will give our readers the benefit of their experience in this line. It is quite true that any improvement which is a distinct innovation is at first accepted reluctantly by the average engineer. Reliability must be proved beyond the shadow of a doubt, and even then the investment is looked upon with suspicion. While conservatism is commendable, when the question of safety is involved, it can be carried to unpardonable lengths when investments for the sake of economy are considered. Small sums intelligently spent in equipment often mean big reductions in coal and repair bills.

The Query Department

Judging from some of the questions sent to our Department of Questions and Answers, many of our readers seem to think that it is not worth while to send in a question unless it is of a highly scientific nature. As all questions of general interest relating to shipbuilding and marine engineering will be answered in this department, provided they are submitted in good faith and the letter bears the name and address of the writer, no one should hesitate to send in questions dealing with the commonplace problems that are found troublesome in every-day work. The performance of an engine can perhaps be greatly improved, from an economical standpoint, if indicator cards taken under service conditions are carefully analyzed and defects, hitherto overlooked, are pointed out, together with the changes that should be made to overcome them. Similarly, in the boiler room, losses due to poor furnace arrangements or improper methods of firing may frequently be reduced by submitting the conditions to an impartial outsider for analysis. In fact, the engine department of a modern steamship includes so many different types of power machinery that the engineer must be particularly well informed to cope with the many problems that arise, if the vessel is to be run at its best efficiency. Under such conditions the query department can be of much value to the engineer, if advantage is taken of the opportunities which it offers for aid.

The Cost of Warships

Elsewhere in this issue will be found a communication from one of our readers who takes issue with some of the statements made in our December, 1914, issue regarding the building of naval vessels in Government navy yards. There seems to be some misapprehension regarding "bids" and "estimates" from private and Government yards. So far as we are aware there is no possible way in which a navy yard can "bid" on work. A navy yard submits estimates and, if the estimates are not realized, it is not clear that anyone is responsible. To finish the work, more money must be appropriated by Congress. On the other hand, a private firm receiving a contract is limited to the contract price. If the work costs more, the contractor is responsible and is the loser. Furthermore, it is not clear what authority there is for stating that "the navy yard estimates are keeping the bids of private contractors down to somewhere near what they should be to give a reasonable profit." It is a well-known fact that many naval vessels have been built at a loss by private builders without any navy yard competition. The failure of the private shipbuilding firms referred to in our December issue, with one exception, was directly traceable to the Government work in which they engaged. Up to the time they took Government work they had no trouble.

As to the greater cost of repairs to a Government-built ship, this statement can be verified from the Navy Department records which have been brought before the naval committee of Congress. Some of these figures were published on page 205 of our May, 1914, issue. While such figures do not necessarily prove that one class of work is better than the other, nevertheless they should not be ignored, especially in the case of sister ships which have been in service for about the same length of time, when other causes than material and workmanship that may affect the cost of repairs will probably average up and may apply to a contract-built ship as well as to navy-yard-built ship.

Our correspondent's statement that "a navy-yard-built ship is constructed from the same specifications as the contract-built ship, which must be followed to the letter," is not strictly correct. As a matter of fact, the contractor

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is held responsible to practically the last ten-penny nail, while in the Government-built vessel many things which are not absolutely necessary are left undone or are done in a different manner from that specified. Furthermore, it sometimes happens that the Government-built vessel is put in commission long before she is finished, and such a ship has even been known to leave a navy yard in an unfinished condition, the fact being that when the appropriation runs short it is necessary to resort to every possible means to complete the vessel in the most economical manner.

To place navy yard estimates and contractors' bids on a competitive basis is a difficult matter, for the reason that navy yard costs cannot be compared directly with the costs in a private yard. Many items which are not charged against work done in a navy yard have to be charged against the work in a private yard. For this reason it is a difficult matter in comparing contractors' bids with navy yard estimates to reconcile such items as interest on the investment in the plant, insurance, taxes, depreciation and profit, which are items of first importance in the first case. In a navy yard various items of labor are chargeable to other accounts and there is no trial trip to be paid for, which is an important item for the private builder to consider. Also, there are no penalties to be considered, either as regards contract time of construction, contract speed of the vessel, contract weights, or other contract requirements.

The question as to how any shipbuilding plant can employ and maintain a skilled and efficient force of men without work to keep them continuously employed is also perfectly applicable to the private shipyard and brings up at once the point that the few large private shipyards in this country capable of doing the work are an asset to the country, which, generally speaking, seems to be ignored. In view of the limited amount of naval work authorized each year it is necessary for the few private shipyards to have continuous, or nearly continuous, Government work if they are to keep their organization in condition to do it. Without proper organization no shipyard can do Government work satisfactorily, more especially that of the larger type, as it would take years to get an organization into proper condition for building a 32,000-ton battleship. We firmly believe that it is very important to this country to keep the few large shipyards which have made a specialty of Government work in an efficient condition.

Classing American Vessels

The comments on page 97 of our March number on the "Classification of American Ships" seem to have hit responsive chords in many directions. Of the many letters we have received regarding these comments one of the most interesting is from a president of one of the leading shipbuilding companies, who writes:

"We should be very glad to see American vessels classed in an American Society; for, if you will review the vessels classed in France you will find that the majority are subject to the Bureau Veritas; those of Germany, to the Germanic Lloyd's, and the Scandinavian countries use their societies. Here at home, as you are of course aware, we class with almost anything that comes handy. I think, however, it would be very difficult at the present time to inaugurate any classification in this country, but feel that it will undoubtedly come when we have more equitable maritime laws, and ship-owing and shipbuilding receive encouragement instead of opposition from the 'Powers That Be.'"

Nothing shows more clearly how much truth there is in this statement than a glance at the records of the different Classification Societies. The last record at hand is dated June 30, 1914, and shows the following steam vessels classed by the different socities:

American Bureau of Shipping	303
Veritas, Austro-Hungarian	352
Great Lakes Register	358
Italian Register	421
British Corporation	935
Norwegian Veritas	1,235
Germanic Lloyd's	1,925
Bureau Veritas	2,833
British Lloyd's	9,648

To analyze these figures and compare the number of steam vessels under each flag with the number of vessels classed in each country's Classification Society would be such a shock to American pride, and such a reflection upon American patriotism, that we will refrain from doing it. However, it seems to us that the subject of classing vessels should call forth positive action on the part of the Federal authorities, and that shipbuilders and ship owners should give evidence of more pride in having an American Classification Society class American-owned vessels built in American shipyards.

Big Profits in New Vessels

It seems strange to those of us who have studied the steamship situation, that more vessels are not being ordered in American shipyards. It is true that in the larger yards no deliveries can be guaranteed inside of about twenty-four months, but several of the yards have berths that are not under contract, and orders can be filled with a considerable degree of promptness. Prices may be somewhat above what they would have been six months or more ago, but it must be borne in mind that continental shipyards have undoubtedly been filled up with naval work to the entire exclusion of merchant marine work since last summer, and the same conditions have obtained in most British shipyards, so that very little merchant marine tonnage has been launched. A few of the British yards are not fitted to handle naval work, and have been turning out more or less merchant marine tonnage, but at nothing like the prices of $40 (£8 10s) per ton or thereabouts which were quoted a year ago. Indeed, recent reports would indicate that with the great increases of cost of labor and material in Great Britain, as well as on the Continent, there is little difference in the cost per ton over recent American prices.

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Investigations made by one of the largest American steamship companies in the United States indicate that any difference in the first cost per ton of American-built and foreign-built vessels in the same service is more imaginary than real. A careful analysis of the operating costs of the two classes of vessels has shown that the delays in port of American-built ships for purposes of making repairs, etc., have been less than those of foreign-built vessels, and, consequently, the earnings of the American-built vessels on the investment have been greater than those of the other vessels.

With so little new tonnage under construction in the shipyards of the world, and the existing tonnage afloat decreasing at an abnormal rate—to say nothing of the interned German vessels deteriorating at the rate of about 25 percent a year—it must be very evident that those people who have vessels to sell after war ends will be able to reap very large profits. With the financial situation as it is it seems strange that people with money to invest do not fill up with orders the few yards that are able to guarantee prompt deliveries.

A Special Naval Reserve and the Merchant Marine

Now that the Congress of the United States has ended its session and the Administration Ship Purchase Bill has been laid away in its final resting place, there is opportunity to calmly discuss the old question as to the best methods of reviving the American merchant marine. The fact that the Administration made strenuous efforts to pass this bill—although along lines never before attempted by a Chief Executive to force Congress to take action contrary to the conviction of a large majority of members of both Houses—shows deep interest in this great and important subject. But all these good intentions were more than counterbalanced by the signing of the Seaman's Bill, which looks like a desperate attempt to strangle what is left of our merchant marine in the foreign trade, and to drive back under foreign flags, at the end of the war, all of the half million and more tonnage of vessels that have sought safety under the American flag.

Even then we shall have far and away the second largest merchant marine in the world, comprising over 8,000,000 tons—nearly twice that of Germany, the third on the list. But we must have ships in the foreign trade as well as the domestic, if there is any possible way of having them. Unfortunately, with this strangling grip on the shipping interests in the foreign trade, it does not seem as though any plans for reviving the merchant marine that have ever been presented to Congress in previous years can succeed. The straight subsidy plan had wonderful vitality. It was apparently killed year after year for a quarter of a century or more, but now is apparently dead for the last time. The proposed preferential duties plan has been up time and time again, but has already brought forth unofficially from foreign nations threats of reprisals if such action is enforced. All of this means not only that irritations and ill-feelings will be stirred up, but also that every commercial treaty which the government has in force must be canceled, and it is a question whether they can ever be renewed with this preferential plan included. Government ownership has now been placed alongside the subsidy and the preferential duties plan in the graveyard.

What can be done to bring about a revival of our merchant marine? The writer had presented to the President and the members of his cabinet, as well as to leading members of Congress, some months ago, a new form of bill which was favorably received by members of the Senate and the House of Representatives, but which could not be taken up seriously, as the Administration had already been drawn into the Government ownership whirlpool. This bill authorizes the United States, acting through a shipping board, to purchase a certain percentage of bonds in legitimate corporations operating ships in the foreign trade, and in this way give encouragement to an industry in somewhat the same manner that practically every industry in the country has been protected by a tariff—only another but indirect form of subscribing to bonds.

But the most important feature of this bill is the plan for organizing a Special Naval Reserve. Only American citizens can benefit by this reserve, and in consideration of masters, watch officers and seamen joining it, they are paid the difference in the American rate of wages and the foreign rate of wages from a specific fund. By carrying out this plan we would not only be building up a merchant marine in the foreign trade which could compete with other nations, but the Government would be training hundreds of men for service in all branches of the navy, in case of emergency, and at a fractional part of what their wages would be were the men regularly employed on naval vessels. The need of such trained men was made distressingly evident when the so-called Spanish war broke out. The navy simply could not find the men to properly man the many auxiliary vessels.

Leading European nations have similar reserves for both their armies and navies. Not only are practically all the men in foreign merchant marines in these reserves, but all classes of men are connected with it. Even taxicab drivers get their little yearly subsidy from their governments to be at the service of the army in case of emergency. By paying the money direct to the men who do the work, so as to bring their wages up to the American standard, as proposed in this bill, greater economic results can be obtained than by paying subsidies on the tonnage basis. It is estimated that $1,000,000 (£205,000) spent in this way will support sixteen ships of 5,000 tons a year, or eight ships of 10,000 tons; consequently, $2,000,000 (£410,000) would keep afloat twice this number of ships.

H. L. ALDRICH.

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French-Built Cable Ship Edouard Jéramec

Steamship of 3,800 Tons Displacement Fitted with Special Machinery for Repairing Trans-Oceanic Cables

BY F. C. COLEMAN

A new twin-screw cable-repairing steamship, named *Edouard Jéramec,* built by the Société Anonyme des Forges et Chantiers de la Mediterranée, of Havre, has recently been completed to the order of the Compagnie Française des Cables Télégraphiques, of Paris. The principal dimensions of the *Edouard Jéramec* are: Length between perpendiculars, 269 feet; beam, 41 feet; depth, molded, 25.9 feet at spar deck; draft, loaded, 17.6 feet; displacement, loaded, 3,800 tons.

The vessel has water ballast tanks throughout the entire length, and there is a double bottom amidships, together with transverse bulkheads. The steel hull and spar deck with central bridge are strengthened in accordance with, and beyond, the requirements of the Bureau Veritas, in view of the fact that the vessel is required for deep-sea work and also for navigation in cold latitudes.

The propelling machinery, which was built at Havre, consists of two triple-expansion engines having an aggregate of 1,900 horsepower and running at 120 revolutions per minute, giving a normal speed under ordinary load of 11 knots, with a consumption of 20 tons of coal. In view of the special nature of the work for which this vessel was built, the engines were so designed that they could be quickly changed from ahead to astern and vice versa, and on the trials, while a speed of 12½ knots was obtained, it was also possible to work the engines at only 11 revolutions per minute, corresponding to a speed of about 1 knot, and at normal speed the direction of the vessel was changed in five seconds.

There are two main boilers of the cylindrical marine type with three furnaces. The total heating surface is 4,170 square feet, and the grate area is 106.5 square feet.

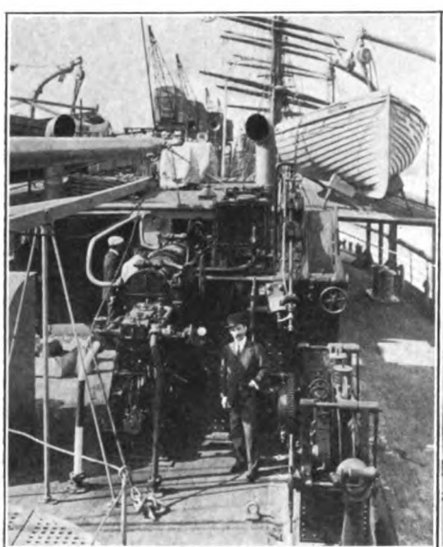


Fig. 1.—After Deck
Fig. 3.—Cable Machinery

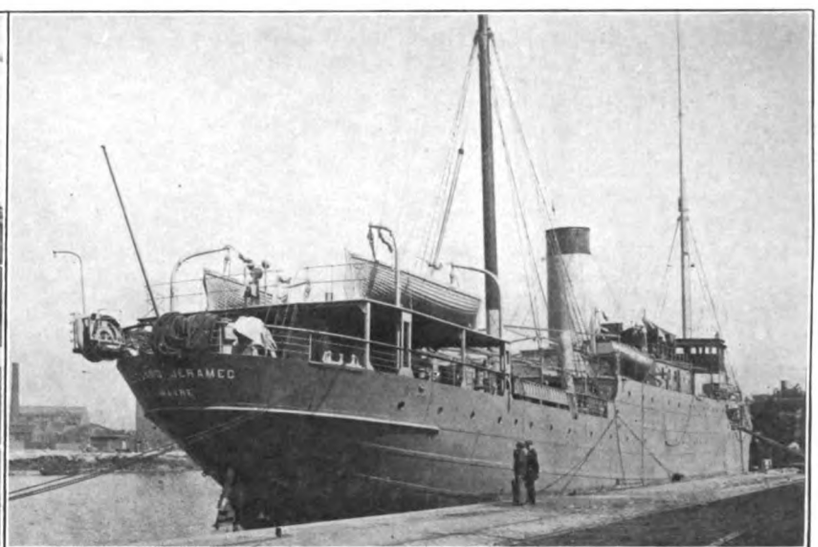
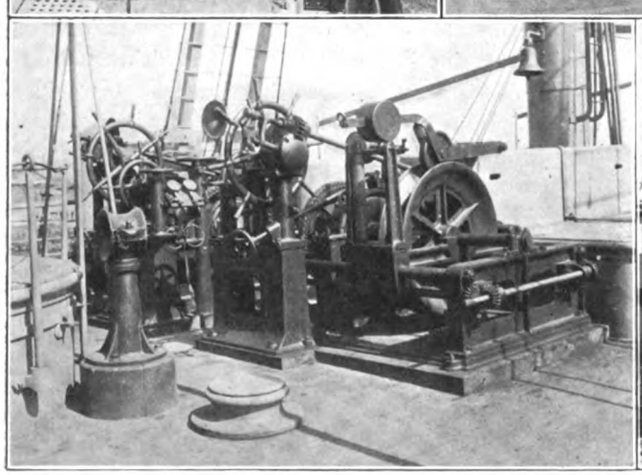
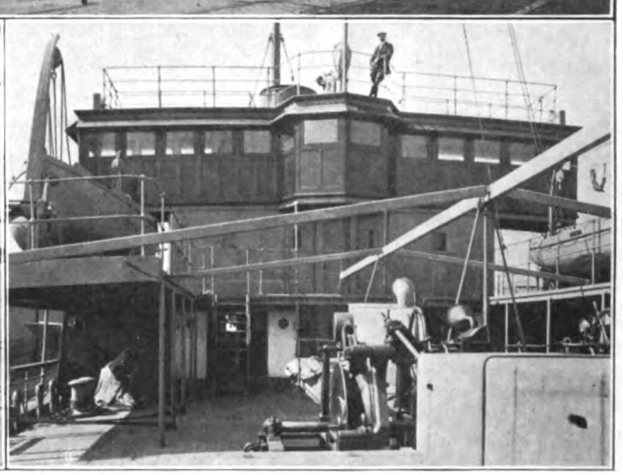


Fig. 2.—Stern View of the *Edouard Jéramec*
Fig. 4.—Navigator's Bridge





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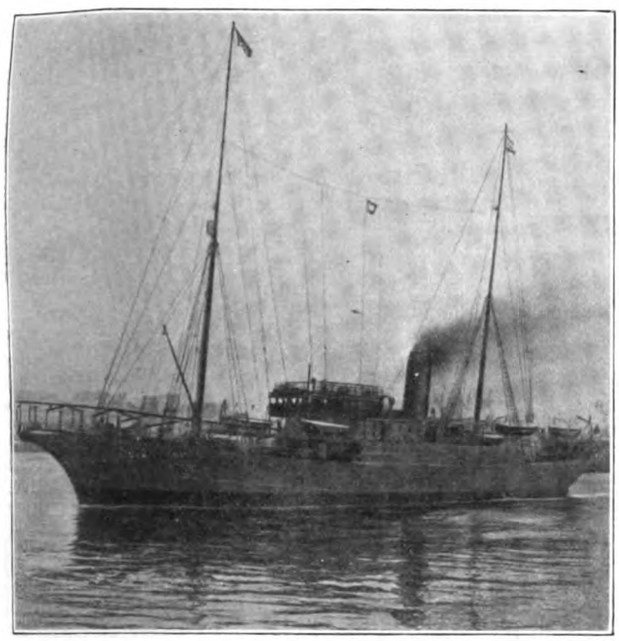

Fig. 5.—Cable Repairing Steamer *Edouard Jéramec*

The boilers are fitted with Howden's forced draft and a steam ash ejector.

The three cable tanks, which have a diameter of 27.89 feet, carry a total of 800 tons of cable. The coal bunkers have a capacity of 850 tons of coal, and there is water ballast, stores, etc., for an expedition of forty days at 1,500 nautical miles from her station without any intermediate port of call.

The auxiliaries include one boiler, a donkey engine of the telemotor type, manufactured by the Atlas Works, two steam winches, one Seager refrigerating machine, one Buhring filter, submarine signaling apparatus, two electrical generating sets of 20 kilowatts and 7 kilowatts, respectively, at 110 volts, two electric ventilating fans for the ventilation of the crew's sleeping quarters, also ventilating fans in each officer's cabin; one projector and one Morse lantern, and one long-range wireless installation provided by the Compagnie Générale Radiotélégraphique, and ordinarily supplied by the ship's lighting circuit, but completed by the provision of a Renault motor of 12 to 14 horsepower in case of damage to the engine room. There has also been supplied by the firm of Grenier Lemarchand, of Havre, a heavy gasoline (petrol) motor boat of 40 horsepower capacity, complete with Welin davit gear. The boats for cable working are also slung on this type of davit.

Cable Gear

The cable gear equipment, which was supplied under contract to the shipbuilders, comprises the picking-up and paying-out machines for working the cable, with the necessary bow and stern sheaves, dynamometers, deck leads, etc., for leading the cable to the machines and overboard, together with turning-over gears, sounding machines, etc. There are two cable machines, one forward for picking-up and dealing with comparatively short lengths of cable over the bows, the other machine being placed aft for paying out long lengths of cable from the stern.

The forward machine is a double combined picking-up and paying-out machine of Messrs. Johnson & Phillips' latest pattern. This double machine is placed between the main and the spar deck, hatches being provided in the spar deck to expose the cable gear drums when working. The two parts of this double machine are capable of being worked quite independently of each other, there being two separate engines, but the machine is so arranged that should it be necessary at any time—in case of a breakdown to one engine—the engine for the port side drum may drive the starboard side drum, or vice versa, while

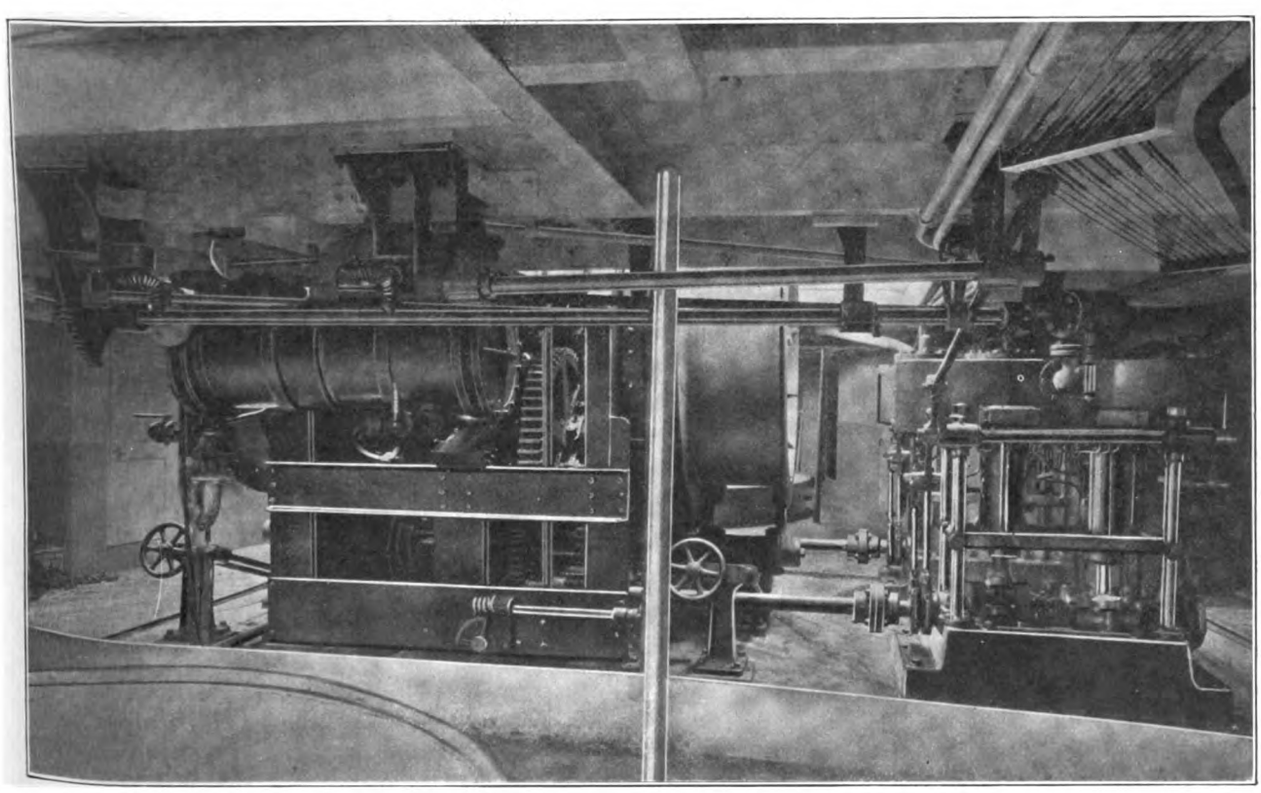

Fig. 6.—Forward Cable Machine

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both engines may work on to either drum when the maximum lift is required. The two engines are placed to one side of the machine, so as to leave the fore and after ends of the gear accessible and to facilitate repairs when necessary.

The engines are twin high-pressure with 8-inch cylinders and 8-inch stroke for a working pressure of 165 pounds per square inch, and each is capable of developing 110 brake horsepower when running at a speed of 300 revolutions per minute, giving a total of 220 brake horsepower for the machine. With this power the machine is easily capable of lifting a weight of 25 tons at a rate of 1 knot per hour, while the other speeds provided admit of lifts as follows: 10 tons at 2½ knots and 6¼ tons at 4 knots per hour.

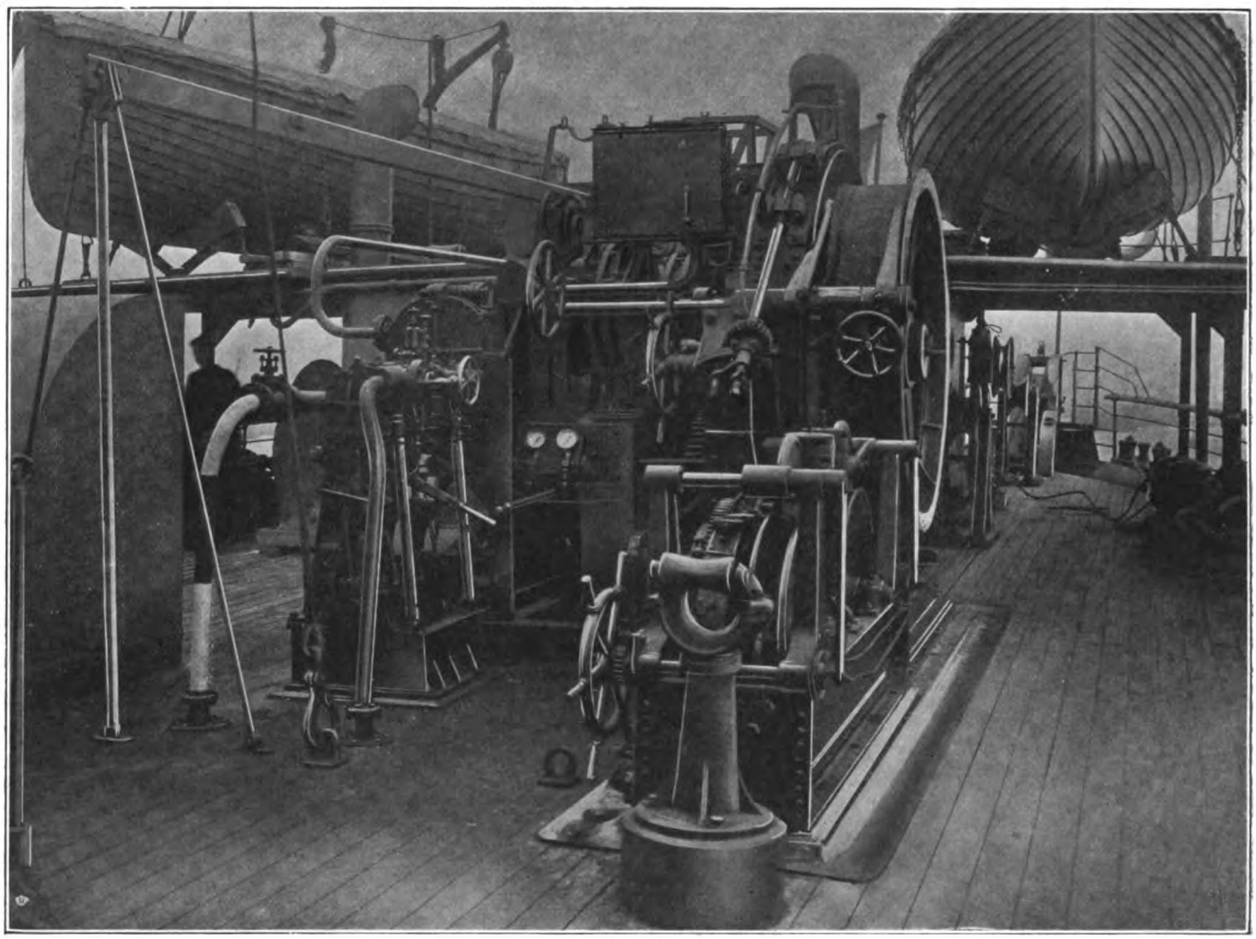

Fig. 7.—Aft Cable Machine

Brakes

The drums, which are 69.6 inches diameter by 19.3 inches wide between the flanges, are made to run loose on the shaft, in accordance with the makers' invariable practice, and they have brake rings attached to them. The brakes consist of steel straps with elm blocks encircling the brake ring, on which they are made to close by means of a double-threaded screw actuated by hand-wheel through the medium of a worm gear, giving a very fine regulation for the lighter strains, and at the same time providing enormous holding power when necessary. To the back of each back strap is fitted a water service pipe, with nozzles at intervals, to direct water between the joints of the brake blocks and right on to the face of the drum, so that the brakes may also be used for paying out.

As regards the brakes, however, the owners stipulated that one side of the cable gear should be provided with hydraulic brakes for paying out long lengths of cable, but they eventually agreed to adopt a new form of rotary oil pump brake put forward by Johnson & Phillips, Ltd., and which enabled the gear to be made more compact than with any form of hydraulic brake. These oil brakes consist of two Helo-Shaw rotary oil pumps, connected directly by double helical toothed wheels to the port or paying-out drum. Each of these pumps circulates the oil through a separate system of pipes having a controlling valve (by which the brake power is regulated) and a cooling chamber. The pumps are of the rotary type, of very simple construction, the revolving member consisting of a bronze body, bored for and fitted with six radial plungers of hardened steel, the plungers having plain hardened steel crossheads carrying gunmetal, bushed, hardened steel rollers at each side, these rollers working in a cam path in the cast steel cheeks of the fixed case.

The revolving body is actuated through its central shaft by gearing from the main drum, and the cam paths in the side cheeks of the fixed case cause the plungers to work up and down in the cylinder. The oil is drawn in and discharged through ports in the central shaft, and there is no valve gear.

The plungers are not fitted with any packing rings, but are plain bodies with a few oil grooves, and any leakage past the plungers finds its way into the casing, which

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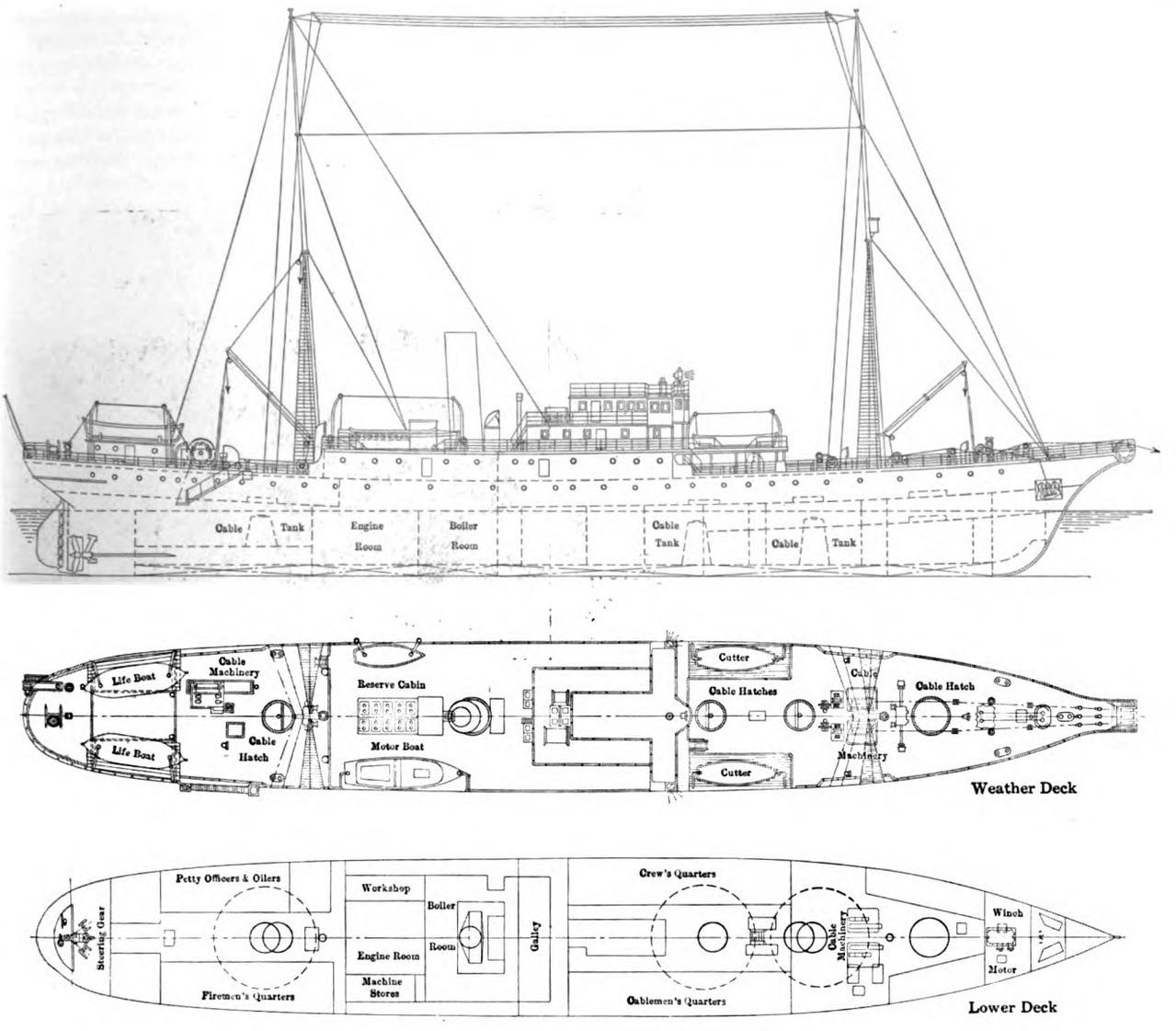

Fig. 8.—Profile and Deck Plans of Cable Repairing Steamer *Edouard Jéramec*

eventually becomes full, hence all the parts are working in oil, the conditions being practically those of forced lubrication. From the top of the casing there is an outlet pipe which carries the leakage oil back to the supply tank.

The relief valve is also connected by a pipe to the supply tank, so that any oil passing is carried back to the tank. The controlling valve is operated from the spar deck by means of a hand wheel through the medium of worm gearing, and pressure gages are fixed alongside indicating the oil pressure. The "hauling-off" and "holding-back" gear stands on the spar deck, and is driven from the geared drum by means of a chain drive, through a friction strap and "free-wheel" arrangement, in such a manner that it is driven in one direction only—viz., for picking-up—whereas it runs free for paying-out, and, therefore, when it is necessary on a picking-up job to reverse and pay out a little slack, the gear is automatic in this respect. This is a great advantage over the old system, with which it was necessary to put a clutch into and out of gear. A screw gear is also provided for traversing the haul-off sheave across the face of the drum to suit an "inside" or "outside" lead, and this can be worked while the machine is running. Screw brakes are provided on this "holding-back" gear.

Actuating Gear

Practically the whole of the actuating gear is operated from the spar deck. The brakes, two steam stop valves, and two reversing gears are all within reach from one position. The hand wheels for putting the fast, medium and slow speeds into gear and for coupling up the drums or brakes are all close at hand, as well as the levers for putting the hauling-off gear into action and all necessary regulating gear. It is only necessary to go below to couple the two engines, or to adjust the fleeting knives when the cable is being passed round the drum.

The special machine placed aft for paying out the longer lengths of cable over the stern is similar in principle to the forward machine, but it is a single machine only, with double jockey holding back gear, and it is self-contained on the spar deck, with all the controlling gear arranged at the after end of the machine. The brakes are similar to those on the forward machine, and comprise both the auxiliary hand brake as well as the rotary oil pump brake. This machine is provided with a small engine of 45 brake horsepower for the purpose of starting-up and for hauling back when necessary, and it is capable of hauling the cable under a strain of 10 tons at the rate

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of ⅜ knot per hour, or under a strain of 1 ton at 3 knots per hour.

The bow sheaves and whiskers have been very neatly incorporated in the bow by the shipbuilders. There are three sheaves 4 feet 3 inches diameter over the flanges, each sheave fitted with cast iron guards which extend practically all round the flanges. Galvanized gratings and rails extend to the extremities of the sheaves. There is one sheave wheel at the stern 3 feet 3 inches diameter provided with similar arrangements as the bow gear.

Dynamometers are fitted both forward and aft to register the strain on the grappling ropes and cable when picking up, and on the cable while paying out. These dynamometers consist of a sheave carried on a slide which is free to travel up and down a vertical cylinder, the inside of which is provided with a plunger working in oil, forming a dashpot, so as to steady the movement and prevent jumping.

The cable leads comprise single and double roller leads, or bellmouths carried on pedestals, on which they can be adjusted for angle to suit the line of the cable. The cable tank hatches are fitted with bellmouth leads carried on cross girders, and the tanks are provided with crinolines which can be lowered as the cable is taken out, to prevent the kinking of the cable.

For transferring cable from one tank to another an electric hauling gear has been provided. This consists of a V-sheave with frames and suitable gearing and an electric motor of 6 brake horsepower supplied from the ship's lighting circuit. The gear is erected on a cast iron bedplate provided with runners for portability about the deck. For deep-sea sounding work an electric sounding machine is provided having a motor of 3 brake horsepower and suitable for sounding in depths up to 5,000 fathoms.

Refrigerating Plant on the First American Steamer to Bring Frozen and Chilled Meats from the Argentine

The arrival of the Barber Line steamship *Dochra* in New York recently with a cargo of frozen and chilled meat direct from the River Platte aroused a great deal of interest, as it marks the beginning of American refrigerated ships for carrying frozen and chilled meats from the Argentine. Previously this class of work has been entirely in the hands of British firms.

This installation of refrigerating machinery was completed on September 1, 1914, and on November 18 the vessel returned to New York carrying a thousand tons of beef, and in addition a large general cargo from Buenos Aires after a passage of twenty-seven days. The trip north was the first practical test given the refrigerating plant, and the beef was landed in New York in excellent condition. No. 3 lower hold was completely filled with frozen meat at a temperature of 15 degrees F., and in Nos. 2, 3 and 4 'tween decks, and in No. 3 hatch trunk, chilled meat was hung and carried at a temperature of 29 degrees F.

When it was decided to fit up the steamship *Dochra* for the carrying of frozen and chilled meat, fruit, etc., Messrs. Barber & Co., the owners, awarded the contract for supplying and installing the refrigerating machinery, brine pumps, brine piping, etc., to the York Manufacturing Company, of York, Pa., through their New York and export representatives, the Shipley Construction & Supply Company. The contract for insulating the various chambers was awarded to the Armstrong Cork & Insulating Company, of Pittsburg, Pa. Mr. Frank S. Martin, of New York, consulting engineer for the owners, superintended the installation.

The ammonia compressors are of the "York" marine duplex, horizontal, double-acting type, tandem connected to a horizontal cross-compound engine. The ammonia

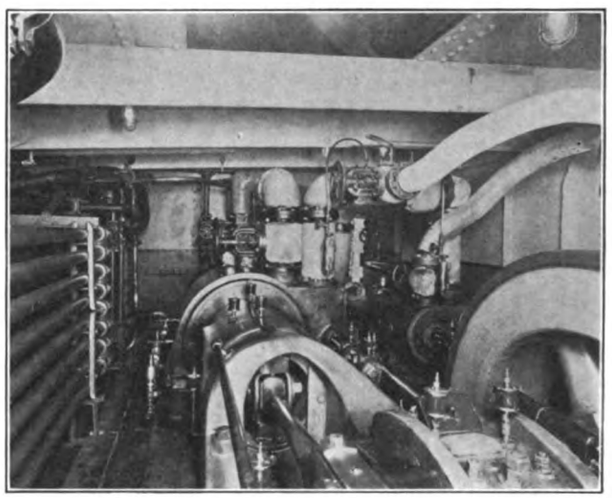

Fig. 1.—York Ammonia Compressor and Shipley Ammonia Condenser on the *Dochra*

condensers are of the double pipe counter current "Shipley" flooded style, arranged for condensing water of 85 degrees F., which is encountered by the steamer during her passage through the tropics.

The brine apparatus consists of double pipe brine coolers, a warm brine tank and two duplex steam pumps which circulate the brine through the different systems in the compartments back to the double brine return tank. Each system has its own delivery and return pipe and each return pipe has a thermometer in the brine room, so that absolute and accurate control can be maintained of the brine temperature and circulation.

All the brine coils in the chambers were made of galvanized pipe with long wrought iron return bends. The meat rails are also of galvanized pipe, covering the full surface of the ceiling, placed in between the brine coils,

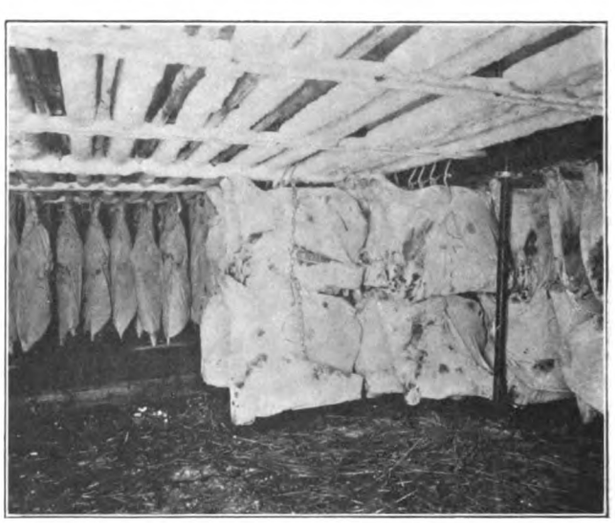

Fig. 2.—'Tween Deck Refrigerated Compartment, Showing Method of Stowing Chilled Beef

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each rail making a continuous pipe from end to end of the compartment in a fore and aft direction.

The insulation consists of granulated cork and cork sheets covered with waterproof felt and 7/8-inch T. & G. boards shellaced and varnished. The refrigerator doors are heavily constructed and arranged to facilitate the loading and unloading with all possible speed.

The *Dochra* is provided with a large donkey boiler and steam condenser, together with an air and circulating pump having separate steam and water connections to the ice machine, pumps, etc., making the entire refrigerating plant a separate unit. Cross-connections are also provided to the main boilers, to the main steam condensers, and to the atmosphere. The ammonia condenser circulating pump is also cross-connected on the water end with the ballast pump.

This is said to be the largest marine refrigerating apparatus that has been installed in the United States, and the test made on completion produced temperatures ranging from 5 to 14 degrees F. The whole installation has proved to be entirely satisfactory, meeting fully the requirements of the owners and of Lloyd's Register of British and Foreign Shipping.

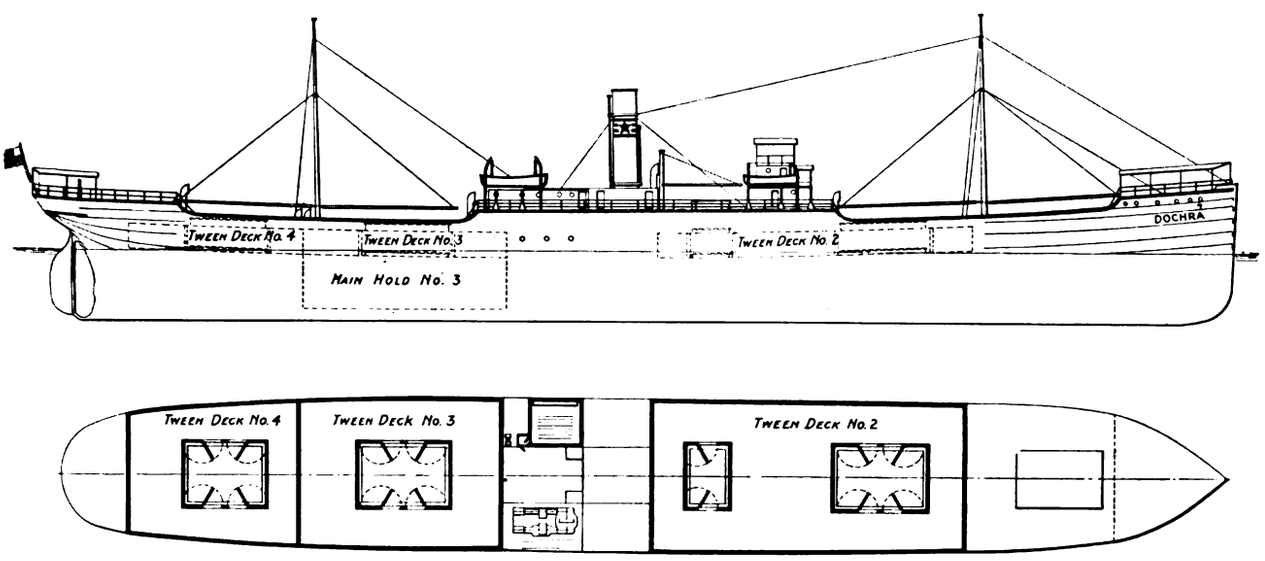

Fig. 3.—General Arrangement of the S. S. *Dochra*, Showing Location of Refrigerating Machinery and Refrigerated Compartments

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VALIDITY OF TERRY TURBINE PATENTS UPHELD.—An important decision is reported as rendered in the United States Court for the District of Massachusetts on March 13, 1915, in favor of the Terry Steam Turbine Company of Hartford, Conn., in its suit for infringement of patents. The decision upholds the validity of the Terry Turbine patent No. 741,385.

PERFORMANCE OF THE ADELINE SMITH.—Remarkably quick deliveries of large cargoes of lumber are now being made by the lumber steamer *Adeline Smith*, which was built in 1912 by the Newport News Shipbuilding & Dry Dock Company to designs by Edward S. Hough, of San Francisco, Cal., for the C. A. Smith Lumber Company, of San Francisco. This vessel runs regularly between Marshfield, Ore., and San Francisco, a distance of 800 miles, and is now making the trip carrying from 1,600,000 to 1,700,000 feet of lumber in 97 hours, which includes the time for loading and discharging the vessel at the terminals.

New Southern Railway Coaling Pier at Charleston, S. C.

The new coal-handling plant being built by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, for the Southern Railway terminal at Charleston, S. C., comprises a novel arrangement for putting coal on board ship after taking it from railroad cars by a car dumper. The dumper itself is of the well-known type used at the recently constructed coal piers at Norfolk, excepting that it is mounted on wheels and will be moved by power along the dock with the coal-loading tower. This tower provides a means of loading coal directly from the car dumper to the ship without the necessity of elevating the coal to the top of a stationary coal pier, as has generally been the custom. In other words, machinery is introduced to take the place of gravity loading.

It is expected that its results will be fully equivalent in speed of loading per unit, and that the coal will be handled much more directly and the breakage thereby reduced to a minimum. The handling of fragile coals in carload lots without breakage is a very desirable feature, and one of the points carefully considered by the Southern Railway Company in designing this pier.

GENERAL ARRANGEMENT

The plant consists essentially of a movable loading tower and a movable car dumper, mounted on tracks located on the coal pier. The tracks for the loading tower are located on the top of the pier. The car dumper is carried on a steel trestle and is designed to travel lengthwise of the dock a distance of approximately 300 feet. This trestle is of sufficient height to elevate the rails of the car dumper approximately 17 feet 8 inches above the top of the dock.

The loading towers are designed to travel along the dock a distance of 300 feet opposite to the car dumper trestle. The yard tracks for the road cars will be carried on trestles, which will form a continuation of the car dumper trestle, and in operation the loaded cars will be brought from the storage yard to the car dumper by means of a yard locomotive. The locomotive will spot the loaded cars on the cradle of the car dumper, which has first been placed in a position opposite the loading tower. The car dumper will rotate the car, discharging the contents into

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a receiving hopper on the loading tower, and this receiving hopper will, in turn, discharge the coal onto a steel flight conveyor carried on a boom attached to the tower. This conveyor will transfer the coal to its outer end, which terminates in a telescopic chute, extending through the hatch opening into the cargo hold. The chute terminates at its lower end in a rotating trimmer, which can be revolved to any position for discharging coal, as desired. The telescopic chute is also capable of being swung athwartships in order to discharge the coal to the sides of the hold.

The car dumper is capable of handling thirty cars per hour, and is designed to discharge coal from any type or size of open top cars in present use. The loading tower is capable of maintaining the capacity of the car dumper.

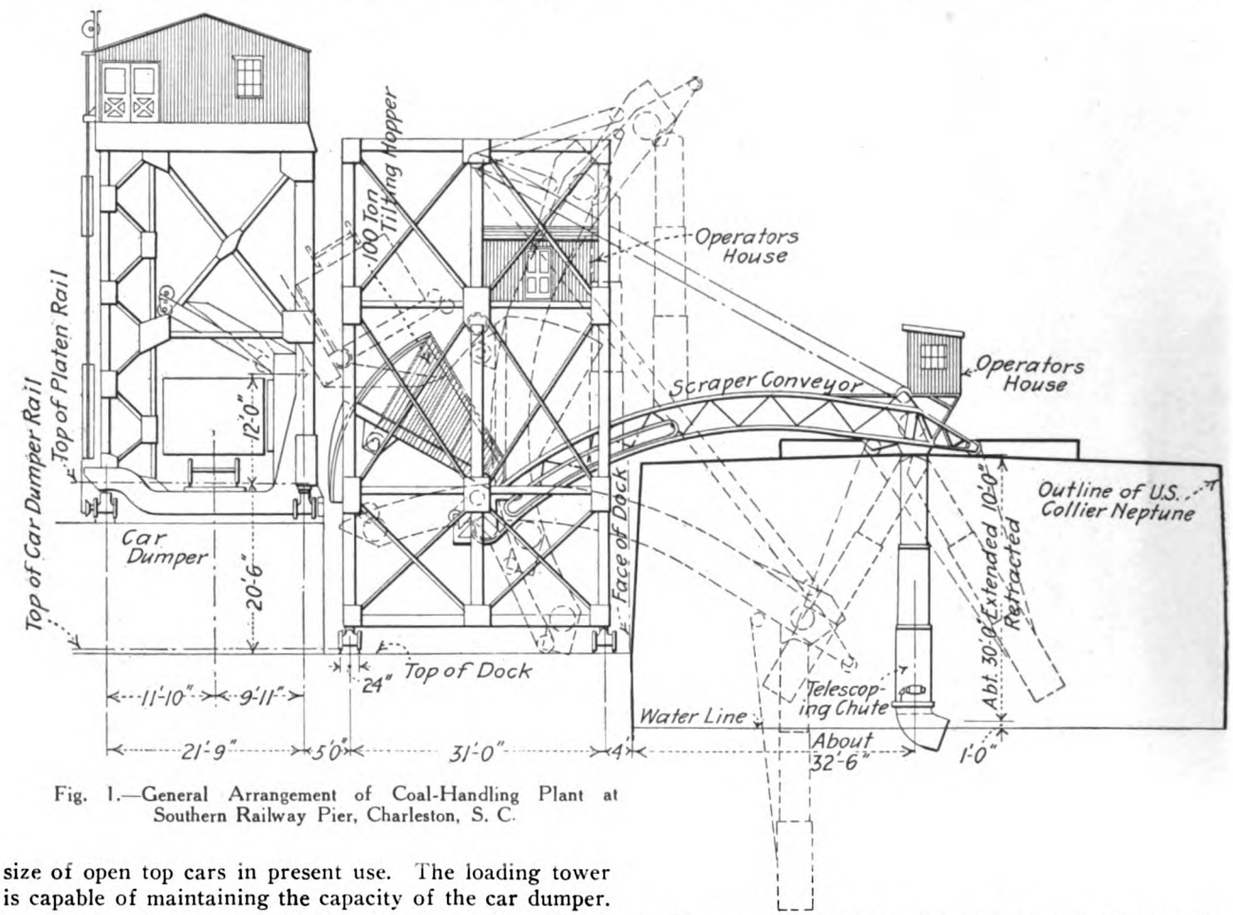

Fig. 1.—General Arrangement of Coal-Handling Plant at Southern Railway Pier, Charleston, S. C.

MOVABLE CAR DUMPER

The movable car dumper is of the Hulett type, which consists of a steel framework carrying operating machinery in a house at the top of the machine. Ropes from winding drums, which are provided with the necessary gearing to connect them to the motors, are connected to the rotating cradle upon which the car is placed for dumping. These motors are under control of the operator, whose cab is located at the incoming end of the car dumper, where he may have a clear view of the work.

The rotating cradle is provided with clamps for securing the car in position on the cradle during the motion of rotation. These clamps are automatically adjustable to different sizes of cars and are operated by counterweights which travel in guides at the rear side of the framework. Their action is entirely automatic in every respect, and they require no attention from the operator.

Each end of the car dumper framework is provided with an incline approach up which the cars are pushed by the yard locomotive when being placed on the car dumper cradle. The discharge end of the car dumper is provided with a similar incline down which the cars run after being dumped and pushed out of the cradle. The points of these approaches are provided with flanges which keep them in accurate alinement with the tracks for the road cars. After a car has been dumped it is displaced by the incoming loaded car and runs down the discharge track to a switchback and thence to the empty storage yard.

The car dumper is mounted on six 4-wheel equalized trucks, designed to travel on four runway rails arranged in pairs 24 inches center to center, the front and back runway being spaced 21 feet 9 inches centers. Four of these trucks are provided with gears which are connected to the travel motor, located in the house at the top of the framework.

This machine is electrically operated throughout and is provided with all modern safety devices. The cradle is rotated by means of two motors of 200 horsepower each and the machine is traveled by means of one 100 horsepower motor. All controllers are of the magnetic switch type, and those for the cradle motors are provided with dynamic braking attachment for controlling the lowering of the cradle after dumping cars.

LOADING TOWER

The loading tower, which is designed to travel along runways between the car dumper and the face of the pier, consists of the steel framework mounted on trucks and provided with a hopper at the rear for receiving coal as it is dumped out of the cars by the car dumper. This hopper is of sufficient size to receive a full carload of coal and is arranged at the forward end so that it is possible to raise or lower the rear end to receive the coal. When the coal is received in this hopper, the flow from

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the hopper to the conveyor is regulated by raising or lowering the back of the hopper, thus allowing the coal to be discharged onto the conveyor, as desired.

The conveyor is carried on a hinged boom supported in the forward portion of the tower framework. This boom is arranged so that it may be raised or lowered by means of ropes attached to the outer end and to the top of the tower. When discharging into boats the outer end of the boom is lowered to the proper position so that the telescopic chute extends through the hatch opening. In the extended position this boom is of sufficient length so that the telescopic chute is approximately 36 feet 6 inches forward of the front runway of the tower. The rear end of the boom is so designed, however, that the boom may be retracted in order to provide a shorter reach when discharging coal into boats of small beam.

This makes a very flexible arrangement, as it is possible to extend and elevate the boom to discharge coal into boats of large beam with high hatches, or it may be lowered and retracted to discharge into boats of small beam with low hatches, the result in each case being that the coal is not elevated beyond the requisite point to discharge through the hatch opening and consequently excessive drop is avoided. When out of service the boom is drawn up and the telescopic chute folded in such a way as to provide clearance for the rigging of ships lying alongside the pier, also to provide clearance if necessary when moving the machine from one hatch to another.

This machine is electrically operated throughout and the motions are controlled by two operators, one located at the outer end of the boom, who controls the scraper, telescopic chute and trimmer, and another operator located on the tower, who controls the hoisting or lowering of the boom, the tilting of the receiving hopper and the moving of the machine along the pier.

The boom hoist and hopper hoist are operated by one 100 horsepower motor, the gearing being provided with clutches to engage either function. The boom retracting and tower moving motion are controlled by one 65 horsepower motor. These motors are located in a machinery house on the tower framework. The conveyor is operated by an independent motor which is mounted on the boom and connected to the sprockets at the outer end of the boom. The conveyor consists of two heavy roller link chains, carrying steel flights which are approximately 2 feet wide by 8 feet long. These flights are spaced 3 feet apart on the chains and are arranged to slide the coal through a steel trough on the bottom at a speed of approximately 150 feet per minute.

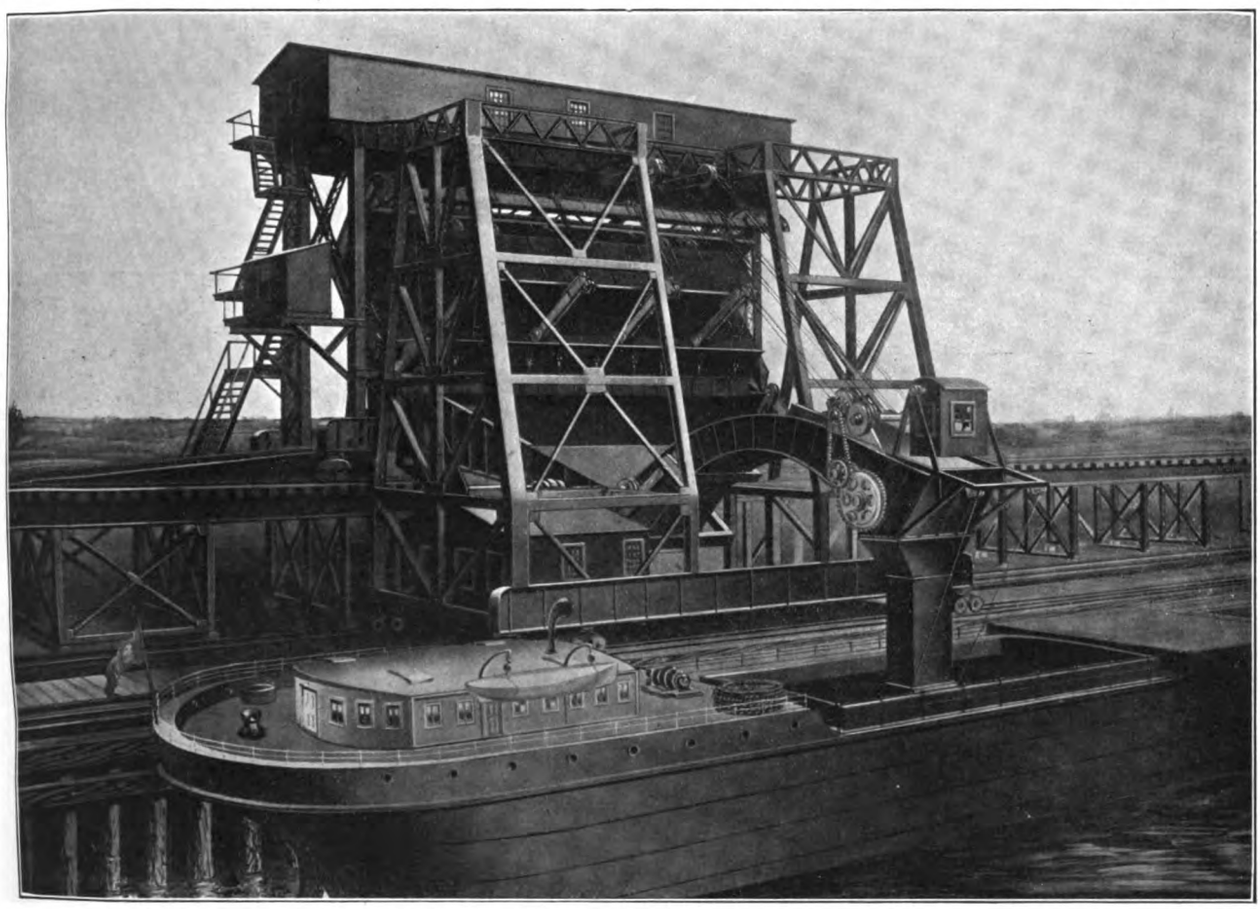

Fig. 2.—View of Southern Railway Coal-Handling Plant Sketched from General Plans

The telescopic chute at the end of the boom is raised and lowered or swung athwartships by means of ropes operated by a 25 horsepower motor, located at the end of the boom. This telescopic chute is made so that it can be extended full length when discharging the first coal into the hold and as the height of the coal increases the chute may be drawn up and telescoped so as to minimize the drop of coal as it is discharged into the cargo hold.

The loading tower is mounted upon trucks of a type similar to those used under the moving car dumper. Four of these trucks will be provided with moving gears for traveling the machine along the pier. When trimming cargo the coal car will be dumped into the tilting hopper and the coal discharged to the conveyor under control, at such speed as is required for trimming.

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Construction of the Welland Ship Canal

Forging a New Link in the Navigation of the Great Lakes —The New Canal Between Lake Erie and Lake Ontario

BY W. A. CRAICK

An undertaking which will have an important bearing on the navigation of the Great Lakes of America is at present under way in the neighborhood of the Niagara River. The project embraces the construction of a ship canal of large capacity to unite the waters of Lake Ontario with those of Lake Erie and overcome the obstacle to navigation interposed by the famous cataract at Niagara. The work has been undertaken as a government enterprise by the Dominion of Canada, and it is being prosecuted at an estimated cost of $50,000,000 (£10,250,000). In point of size and in the nature of the engineering difficulties to be surmounted, the project stands second only in importance to the great canal at the Isthmus of Panama itself.

The canal now under construction is in reality the fourth Welland canal. The first was completed in 1833 and was at best but a small and insignificant piece of work. The locks, forty in number, were built of wood, their dimensions being 100 by 22 feet, with eight feet of water on the sills.

The first canal was under private ownership, but in 1841 it was acquired by the Canadian Government, which at once began to enlarge it. The work required twelve years for completion, but at the end of that time both the channel and the locks of the original canal were fully doubled in capacity. The length of the main canal was then 27½ miles, on which there were 27 locks and the minimum depth of water was 10 feet, with a bottom width of 50 feet.

In 1872, when plans for a second enlargement of the canal were submitted to the Government, it was estimated that from one-half to three-fourths of the shipping on the upper lakes was prevented by reason of the smallness of the canal from descending to Lake Ontario. The third and present canal, opened in 1887, remedied this state of affairs for the time being. The old route was discarded from Lake Ontario to the escarpment, and in its place a new and more direct route was surveyed. The prism of the canal was made 100 feet wide at the bottom and its length was reduced from 27½ to 26¾ miles. The locks, twenty-six in number, were made uniform in size, being 270 feet long, 45 feet wide, with a minimum depth of 14 feet.

While the rate of increase of traffic through the Welland Canal until recently has been comparatively slow, nevertheless in 1912 it reached 2,851,915 tons. During the same year, however, the combined freight tonnage through the American and Canadian canals at the Soo was nearly forty times as much. The deduction most easily made from these figures is that the comparative smallness of the Welland Canal, prohibiting the passage of many of the larger ships used in upper lake service, has kept down the possible tonnage through the canal.

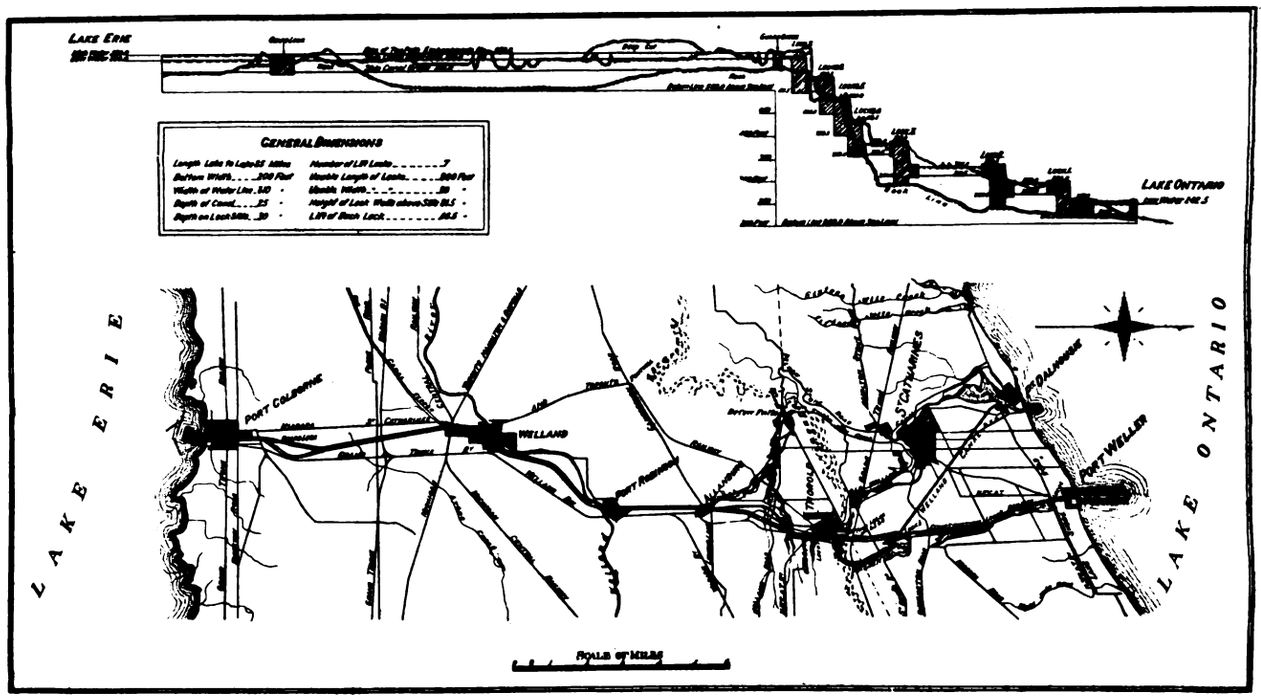

Fig. 1.—Plan and Elevation of New Welland Ship Canal

The New Ship Canal

The necessity for bringing the Welland Canal up to the standard of the Soo canals and thereby providing uniform accommodation for ships from the head of the Great Lakes to Lake Ontario, was impressed on the Government of Canada quite early in the present century. Surveys were begun several years ago and carried to completion in 1911. Preparations of contract plans were made the following year, and in 1913 tenders were let for certain sections of the work and actual operations were be-

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gun. The present year has seen a substantial start made with the undertaking, which, under present financial conditions, will probably take seven or eight years to complete.

John L. Weller, who had been superintendent of the old canal, was appointed engineer-in-charge of the new ship canal.

The new canal follows the course of the old canal from Lake Erie to Allanburg about half-way across the Peninsula, and just above the summit of the Niagara escarpment. From Allanburg an entirely new cutting is being made, crossing the present canal twice and entering Lake Ontario at the mouth of the Ten Mile Creek, three miles to the east of the old outlet at Port Dalhousie.

The Proposed Locks

The spectacular feature of the new ship canal will be the locks. At present there are twenty-six of them overcoming a rise in level between the two lakes of 325½ feet. This number will be reduced in the new canal to seven, each with a lift of 46½ feet. Of the seven, three are double locks, permitting ships to pass each other, one going up and the other going down. Locks Nos. 1, 2 and 3 bring the level of the canal up to that at the base of the escarpment, Nos. 4, 5 and 6 arranged in flight, lift it to the top of the hill, and No. 7, a short distance beyond, carries the level to that of Lake Erie.

The dimensions of the locks are to be 800 feet in length by 80 feet in width in the clear, and with 30 feet of water over the mitre sills at extreme low stages on the lakes. The lock walls are to stand 82 feet high above the top of the gate sills, and, including the necessary foundation work required below this level, two of the locks will have walls 100 feet high. Just by way of comparison and to show that the Welland Canal will not fall very far short of the Panama Canal as a notable engineering work, the dimensions of the locks at Panama may be interpolated at this point. They are 1,000 feet long by 110 feet wide, with a minimum depth of water over the sills of 41⅓ feet.

A particularly interesting feature in the case of the Welland locks is the gates. Hitherto lock gates have been invariably of the double-leaf type, hinging at either side and mitering in the center when closed. On the Welland Canal an attempt will be made to demonstrate the superiority of the single-leaf type of gate. These will hinge at one side and will rest when closed in a notch cut in the opposite wall, a single leaf thus spanning the whole width of the lock chamber. These gates will not sit at right angles to the walls, but will close obliquely, an addition of three feet in the length of the gate over the width of the lock bringing the point of contact 23 feet down the lock wall. The gates will be constructed of steel and the larger ones at the foot of each lock will measure 83 feet in height by 88 feet in length, and will weigh about 1,100 tons. Compared with these huge structures, the largest gates at Panama are dwarfed.

Water for filling the locks will in each instance be drawn from a regulating basin, situated beside or above the lock. This method of drawing water from a side pond instead of directly from the canal above avoids the formation of objectionable currents and surges in the channel and locks, which are a danger to navigation and a serious corroding influence on the earthen banks as well. The regulating basins vary in size.

By means of a system of valves and culverts of large dimensions in the lock walls, it will be possible to fill the chambers in eight minutes. This will reduce the time of passage through the canal, as compared with the time through the present canal, very materially. It now takes ships from twelve to eighteen hours to pass from lake to lake. In the new canal the same ships will be able to run through in from six to eight hours. What this means in a trip from Lake Ontario to Lake Superior in the limited period of lake navigation is easily seen.

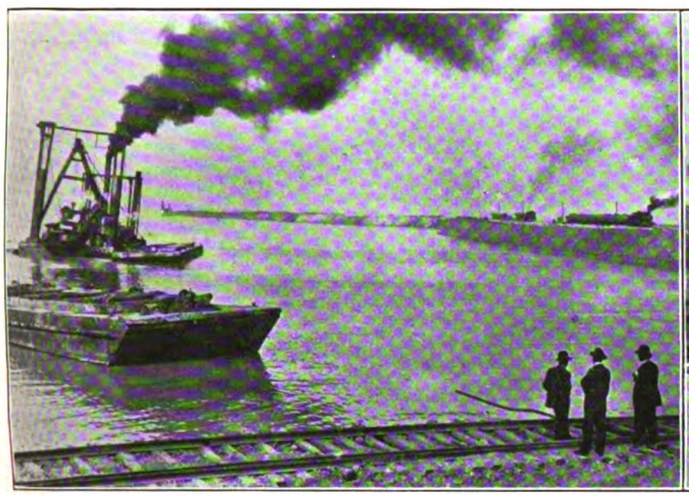

Fig. 2.—View from Inner End of Port Weller Harbor, Showing Pier and Embankments

Fig. 3.—Lake Ontario Outlet of Canal. Harbor Being Dredged to Uniform Depth of 25 Feet

Part of the saving of time, it is true, is to be accounted for by a reduction in the length of the canal. The new route, being more direct, cuts off fully a mile and a half from the old route. It is approximately twenty-five miles long or just one-half the length of the Panama Canal. For the present the canal reaches are to be excavated to a depth of 25 feet, but eventually this will be increased to 30 feet, all the permanent structures being built to that standard. The width at the bottom of the channel is to be 200 feet, as compared with 300 feet in the case of the Panama Canal.

Interesting Features of the Work

At the Lake Ontario end of the canal it has been found necessary to build a complete new harbor, since there was absolutely no accommodation for ships at this point. Work on this particular feature has been carried on vigorously during the past year. The outer entrance piers are to be placed a mile and a half from shore, where the

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depth of the water is 30 feet. From the shore line of the lake to these piers an embankment 500 feet in width will be formed on either side of the channel, protected near the shore end by reinforced concrete cribs with concrete superstructure, alongside which vessels may lie. The whole space between the embankments is being dredged to a depth of 25 feet.

Above Allanburg, it is scarcely necessary to say, by widening and deepening the existing channel, the remaining portion of the canal will be brought to the standard of the new section. Some enlarging work will be necessary at Port Colborne, the entrance to the canal on Lake Erie. To secure quiet water in the harbor during storms, which is not the case now, a new spur, consisting of an immense rubble mound of stone from the excavations to the north, will be added to the western breakwater. It will terminate in a timber and concrete head-block, located some 2,000 feet farther out in the lake than the end of the breakwater. Here again, as at Port Weller on Lake Ontario, the harbor will be dredged to the 25-foot depth for the present.

Work on sections 1, 2, 3 and 5 of the nine sections into which the canal has been divided has been prosecuted up to the present time. These embrace the greater part of the northern half of the canal and include all the most difficult problems to be met with in construction. Chief among these have been the presence of two steam railways right in the path of the canal. One of them crosses the canal at the foot of Lock No. 4. The other runs along for a considerable distance on the very line of the waterway. In the former instance a temporary deviation is being arranged until the construction work is completed. In the latter a permanent deviation, calling for a deep cut through the corner of a hill, has been necessary, work that has cost in the neighborhood of $100,000 (£20,500).

Apart from these obstacles, however, there have been no very serious difficulties encountered so far. The only piece of permanent work yet to be noted along the route is the retaining wall that will extend from the harbor at Port Weller to the entrance of Lock No. 1. This wall is being built of steel framework, of the shape of right-angled triangles standing with their right angles at the base on the inside of the canal prism. They are reinforced with steel rods and filled in with concrete, forming a series of huge pockets into which earth and stone is packed. This method of construction is claimed to be as solid and more economical than all concrete.

The estimated cost of the Welland Ship Canal is placed at $50,000,000 (£10,250,000). This sum may be compared with the total cost of the three canals that preceded it, amounting to $29,250,951.01 (£6,000,000) on March 31, 1913. That is to say, the new canal will require an expenditure of capital amounting to two-thirds as much again as all that has been spent on the route already.

While the new canal will harmonize with the Soo canals and will give access to Lake Ontario to practically every ship now plying on the waters of the Upper Lakes, the route to the Atlantic will not be fully open until the canals along the St. Lawrence River are correspondingly enlarged. At present these canals—the Lachine, the Soulanges, the Cornwall and the Williamsburg—have been built to a 14-foot standard with locks 270 by 45 feet. In one or two instances locks 800 feet in length have been substituted, but the entire system will have to be gone over before it conforms with the Soo canals and the new Welland Ship Canal. When this day comes it will be possible for big ocean-going vessels to sail through to the head of the Great Lakes, gaining access thereby to the very center of the continent.

Stability of Vessels as Affected by Damage Due to Collision*

BY WILLIAM GATEWOOD

Stability is a subject which should receive consideration before the dimensions of a vessel are settled. The height above base line of the initial metacenter can be determined, with a fair degree of accuracy, by the use of coefficients. A convenient formula is

$$\text{Metacenter above base} = aH + c\frac{B^2}{H}.$$

In this formula H represents the draft and B the beam of the vessel; aH is the height of the center of buoyancy above base and $c\frac{B^2}{H}$ is the height of the metacenter above the center of buoyancy. For coastwise passenger and freight steamers of modern design having fine load waterline forward and full midship section, the coefficient a will vary between .57 and .54, depending on coefficient of fineness and exact shape of lines, and decreasing for the same vessel about .01 as the draft increases from 12 feet to 24 feet. For the same type of vessel, the coefficient c will vary between .078 and .082, depending on the exact shape of the load waterline and the fineness of the vessel. For the older vessels, with considerable deadrise and with V-shaped lines forward, both coefficients will be found to be greater. If they had not taught that increase in beam does not, *ipso facto*, imply increased resistance to motion, the model tanks could be blamed for a reduction in metacentric height on passenger steamers, because they are responsible for small deadrise and for fine load waterlines forward on vessels which are designed to obtain a good speed on small horsepower.

The determination of the height of the center of gravity above base cannot be approximated so readily. The vessel, as completed and loaded, can be considered as composed of six items:

1. The hull and fittings below the highest continuous deck.
2. The hull and fittings above the highest continuous deck.
3. The machinery.
4. The fuel and water.
5. The passengers, crew and stores.
6. The cargo.

In the preliminary stages of the design, an approximation of the weight and vertical center of gravity of each of these items may be made, and the results combined, in order to get an approximate figure for the height of the center of gravity of the loaded vessel. An inclining experiment made on the vessel when completed will serve to eliminate uncertainty as to some of the items, generally the first three. The last three items are variable quantities, and must be figured, at best. It has been proposed to determine the metacentric height of vessels before each voyage by inclining them as soon as the cargo is on board. Experience in inclining vessels at a shipyard indicates that the results would not be likely to be reliable, as the readings are affected so greatly by loose water and moving people. Greater accuracy is likely to be obtained by determining beforehand how much weight of cargo is to be stowed in each division of the vessel in order that the center of gravity of the cargo may not exceed a certain

* A paper read before the Society of Naval Architects and Marine Engineers, New York, December, 1914.

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height above base, considered desirable in order to obtain a predetermined minimum metacentric height under the most unfavorable conditions of bunkers likely to occur on the voyage.

This leads up to the question: What is the minimum metacentric height for any vessel consistent with safety?

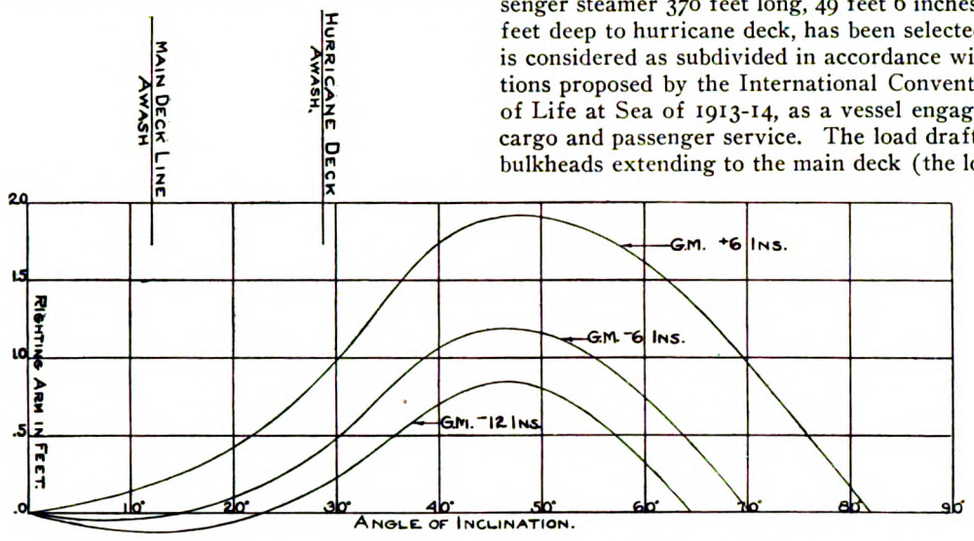


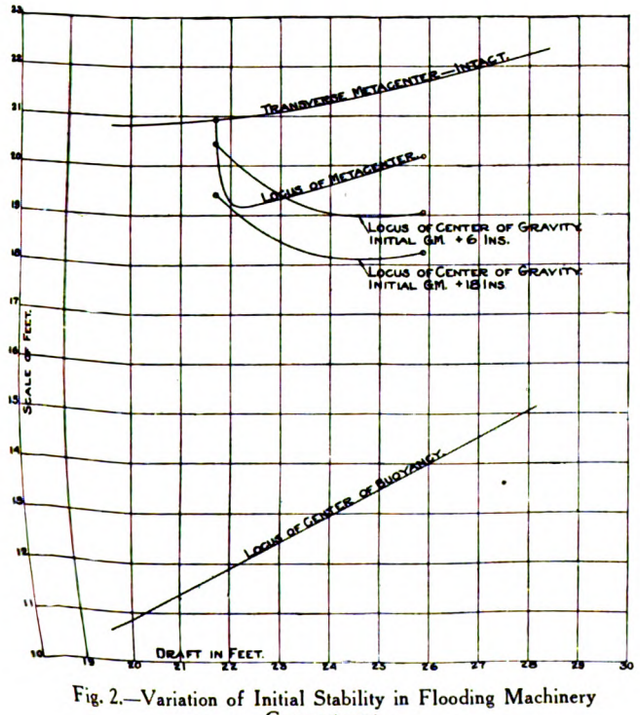
Fig. 1.—Stability Curve, 370-Foot Steamship—Intact—21.7 Feet Draft

The question is susceptible of several answers, depending on whether the vessel is considered as intact and exposed to storm and waves, or as "damaged" either in still water, in a moderate sea, or exposed to storms.

In general, it may be stated that passengers prefer a vessel with a long period of roll, as the discomfort is much reduced thereby. To obtain a long period it is necessary to have a large vessel or a small metacentric height; and the combination of the two requisites in the large Atlantic liners renders travel on them a pleasure instead of a bugbear to the landsman with a "sympathetic" stomach. If the small metacentric height is accompanied by a high freeboard and a considerable range of stability, there is small danger of capsizing, due to wind and waves, while "intact." This "comfortable" condition of a vessel, however, may be a source of great danger even in still water if the vessel is damaged by collision.

To illustrate the conditions obtaining, a coastwise passenger steamer 370 feet long, 49 feet 6 inches beam, and 35 feet deep to hurricane deck, has been selected. The vessel is considered as subdivided in accordance with the regulations proposed by the International Convention on Safety of Life at Sea of 1913-14, as a vessel engaged in a mixed cargo and passenger service. The load draft allowed with bulkheads extending to the main deck (the lowest point of which is 26.92 feet above base) and with machinery compartment 65 feet in length, is 21.7 feet. At this draft it is assumed that the cargo is so loaded that the metacentric height is 6 inches. The range of stability, as shown on Fig. 1, figures out at 82 degrees, and the maximum righting arm is 1.9 feet at 48 degrees inclination. It would be a pleasure to sail on this vessel under such conditions.

Now let us suppose that the machinery compartment is opened to the sea by collision, that the permeability of this compartment is .80, that the water surface in the damaged compartment at all stages has an inertia coefficient of .80, and that the water has free access across the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LOCUS OF METACENTER.
LOCUS OF CENTER OF GRAVITY. INITIAL G.M. +6 INS.
LOCUS OF CENTER OF GRAVITY. INITIAL G.M. +12 INS.
LOCUS OF CENTER OF BUOYANCY.
SCALE OF FEET.
DRAFT IN FEET.

Fig. 2.—Variation of Initial Stability in Flooding Machinery Compartment

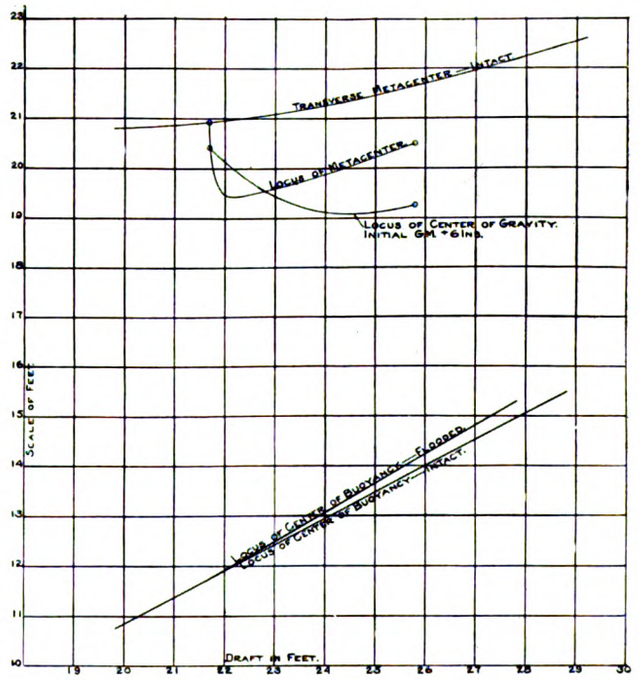
TRANSVERSE METACENTER—INTACT.
LOCUS OF METACENTER.
LOCUS OF CENTER OF GRAVITY. INITIAL G.M. +6 INS.
LOCUS OF CENTER OF BUOYANCY—FLOODED.
LOCUS OF CENTER OF BUOYANCY—INTACT.
SCALE OF FEET.
DRAFT IN FEET.

Fig. 3.—Variation of Initial Stability in Flooding No. 2 Hold

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compartment. As the compartment fills, the center of gravity of the vessel and contained water would fall as indicated by the line marked "Locus of center of gravity" in Fig. 2. The center of buoyancy would rise as indicated by the line marked "Locus of center of buoyancy." The metacenter would fall as indicated by the line marked "Locus of metacenter."

A condition of unstable equilibrium is indicated almost as soon as the water begins to enter the vessel. If the vessel remained upright so that the center of gravity of the entering water would be on the centerline of the vessel, this condition of instability would continue only until the compartment was one-third full and a draft of 23.1 feet was attained. The metacentric height would rapidly increase as additional water entered, and would become as much as 1.1 feet at 25.9 feet draft, when the water would cease to flow in, having attained its level. The freeboard to main deck in this condition would be about 12 inches, and there would appear no reason why the vessel should not stay afloat in a perfectly calm sea, although the margin of safety as regards freeboard would seem insufficient except under ideal conditions of sea and weather.

But the combination of unstable equilibrium and the inflow of water from one side would surely cause the vessel to list toward the damaged side. This list would continue to increase even after there was a positive metacentric height indicated by the diagram, owing to the fact that the center of gravity of the flooding water would lie toward the low side, as obstructions would prevent a rapid flow across the compartment. Fig. 1 shows that the list caused by the negative *GM* would cause the main deck at the side to be submerged. When the main deck at the side is submerged, the water will flow forward and aft along the deck and flood the adjacent compartments, as well as further lower the metacenter. The list will continue to increase, and the vessel to settle deeper in the water and finally sink. The time elapsing from moment of damage to complete submergence would depend on a number of circumstances, but recent collisions have shown that not over fifteen minutes is sufficient.

After complete submergence, there would be a righting moment, due to the fact that the materials of the houses, etc., would be of less density than the material of the main hull. The cargo might be of such varying density as to give a righting moment also. It is probable, therefore, that as the submerged vessel rests on the bottom she would approach a vertical position with masts upright, or nearly so.

From Fig. 3 it will be noted that the conditions are not far different when No. 2 hold, 76 feet in length, is flooded. Permeability is taken at 64 percent.

It would appear, then, that in order to prevent this vessel from overturning when one compartment is open to the sea by collision, it is necessary that the initial metacentric height should be sufficient to prevent a condition of instability in any stage of the flooding. For the particular vessel which has been investigated, the initial metacentric height must exceed 1.4 feet by a margin sufficient to allow for the upsetting moment caused by the fact that in the process of flooding an excess of water will be on the damaged side.

If this vessel has an initial metacentric height of, say, 2 feet, and is subdivided in accordance with the rules of the International Convention, and when at the draft allowed by those rules is injured in a collision, with the consequent flooding of the machinery space or of an adjacent hold, the danger of overturning would seem to be eliminated, provided the sea is smooth. But if the permeabilities established by the conference represent average practice, the freeboard to the top of the bulkheads will be only about 12 inches. It would appear that, if the cut in the side is of any size, a very moderate sea would serve to send the water forward and aft of the damaged compartment, over the tops of the bulkheads.

The results of this investigation would seem to show two things:

First, for a coastwise passenger and freight vessel of the hurricane deck type, subdivided in accordance with the rules of the International Convention as a Class B vessel, and having a machinery space or holds of about one-fifth the length of the vessel, an initial metacentric height of not less than 18 inches should be an important element of the design.

Second, greater safety would be obtained by extending the bulkheads to the hurricane deck, or by otherwise preventing the flow of water fore and aft on the main deck.

Installation of 120 Horsepower Bolinder Oil Engine in Pilot Schooner Gracie S

The San Francisco Bar Pilots have recently installed a 120 horsepower Bolinder oil engine in the pilot schooner *Gracie S*. In many ways this installation is unique, both because it is the first of its kind on the Pacific Coast, and because the shaft is carried out through the port side of the vessel and supported by a strut instead of being located on the centerline. In order not to destroy the vessel's handling qualities, the center of the engine shaft was kept almost at the center of lateral resistance, so that the effects of the propeller on the steering would be neutral with the vessel going ahead.

The *Gracie S* was built at the Union Iron Works, San Francisco, in 1893. She is 83 feet long by 24 feet 7 inches beam, with a depth of 10 feet 2 inches, a gross tonnage of 91.4 and a net tonnage of 86.83. This little vessel is

Fig. 1.—Pilot Schooner *Gracie S*

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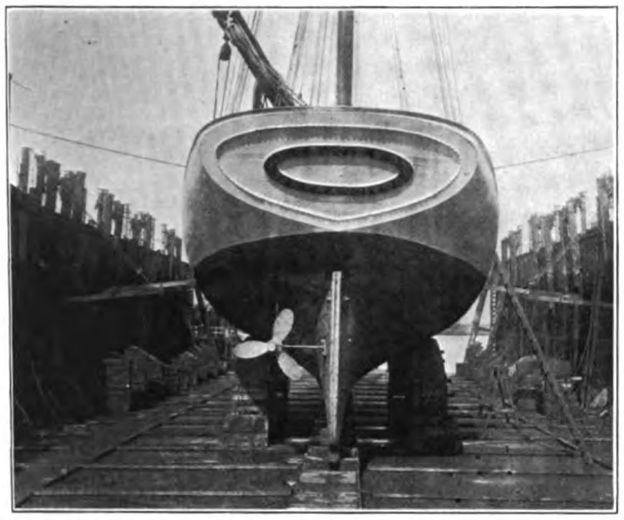

Fig. 2.—Propeller Located on Port Side of Vessel

of exceedingly staunch and heavy construction. On opening her up to install the shaft log in her side, the planking, frames and ceiling were found to be as solid and sound as the day they were put in.

It will be seen from Fig. 3 that the space on the port side formerly used as the dining room has been converted into an engine room, while a small dining room, having a capacity for eight pilots, has been retained on the starboard side. The forecastle forward, which has accommodations for a crew of six, remains practically unchanged; the galley occupies the same space as formerly. The pilots' quarters aft, which contain six berths, lockers, toilets, etc, remain practically the same as before, except that the water tanks, with a capacity of about 850 gallons, are placed under the floor, a space which was formerly occupied with pig-iron ballast, about forty tons of which was removed.

The alterations in the hull necessitated by the engine installation were made by Bowes & Andrews, in accordance with plans by and under the supervision of D. W. & R. Z. Dickie, naval architects, of San Francisco, Cal.

The main fuel tank, holding 737 gallons, is on the port side abreast the engine. A steel trunk skylight was fitted over the engine room extending past the main mast so as to hold the day tanks on deck.

Change of Trim

When the ballast was removed the vessel came up to a draft of 9 feet 10 inches forward and 7 feet 8 inches draft aft. After the installation was made, about 11 tons of loose ballast, consisting of steel plate punchings, was put in so as to trim the vessel properly, and when ready for sea her draft aft was 9 feet 11 inches.

Comparing her former trim before conversion with her finished waterline, it was found that she was up 5½ inches forward and 4½ inches aft, which corresponds to a decrease in displacement of 10¾ tons. Furthermore, her center of gravity is about 6.82 inches higher, due to the new arrangement of weights.

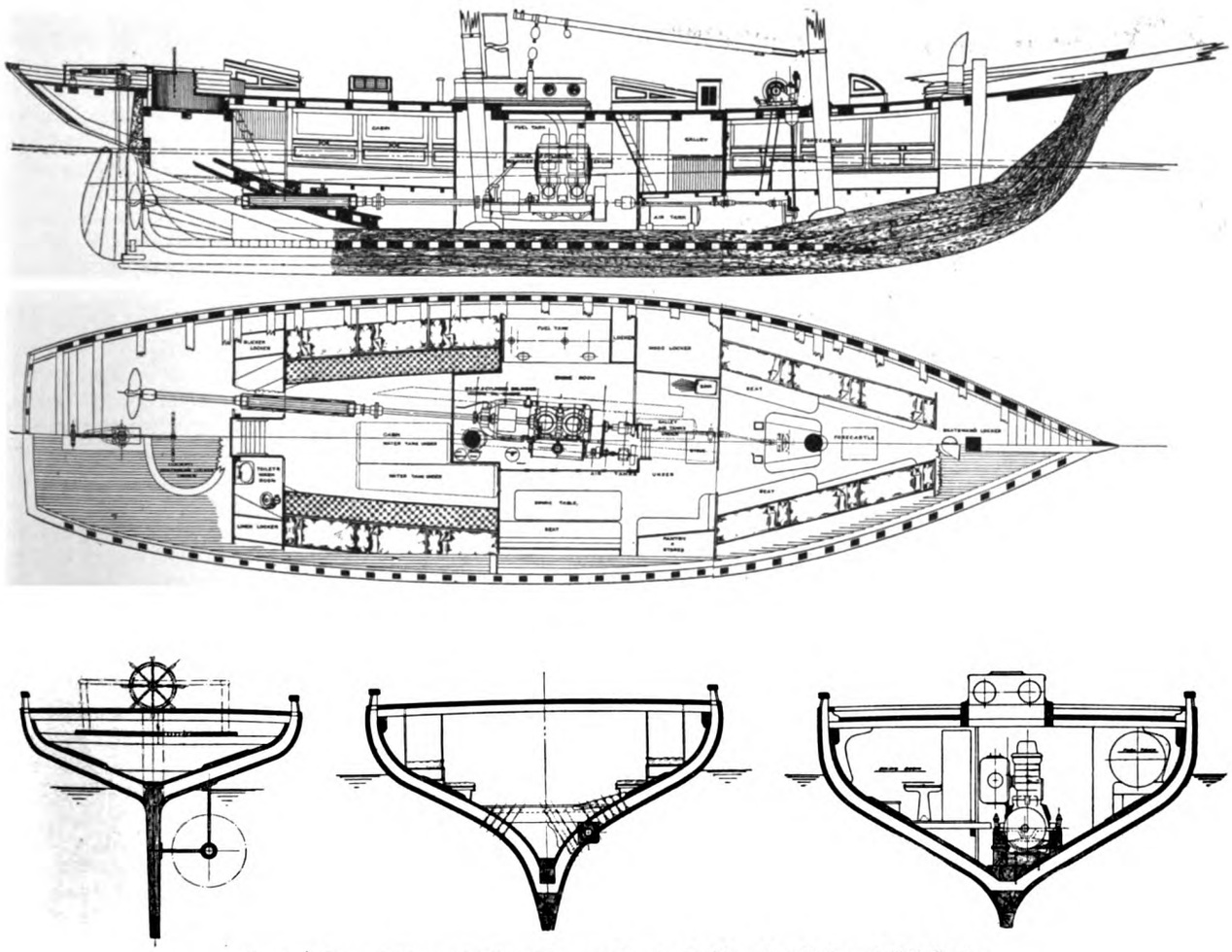

Fig. 3.—General Plans of Pilot Schooner *Gracie S*, After Installation of Oil Engine

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On top of the engine room trunk skylight a ventilator stack was fitted in which the exhaust muffler and two whistles were carried. One of the whistles was an ordinary three-chime steam whistle and the other a Holman air whistle.

No auxiliary engine was fitted, but the bilge pump on the main engine was connected to a fire hydrant on the skylight trunk on deck, and a Gardner & Rix air compressor 4½ inches by 4½ inches, was arranged to be driven by a chain drive through a counter shaft and clutch.

Electric Installation

Hanging on brackets is a 45-volt, 1 kilowatt, direct current Bullock generator, running 1,200 revolutions per minute, which is driven from the counter shaft by means of a belt, it having been determined by previous experience that the running time of the engine during the day while on pilot duty would just about keep the storage batteries charged to operate the lights at night.

Fig. 4.—Engine Room

An Edison storage battery of twenty-five cells, of 80-ampere-hour capacity, giving 30 volts, was fitted, and on test it was found that after charging for eight hours the battery would carry all the lights that are usually burned in service for forty-four hours without recharging. The entire electric installation was made by the Marine Electric Company, of San Francisco. In order to light the dining room during the day, French plate glass was fitted in the panels of the engine room bulkhead.

On the deck forward, just aft of the mainmast, a No. 2 Hyde windlass of the yacht type was fitted. The worm gear is driven by means of a shaft and clutch from the main engine. The old steering gear was replaced by a No. 4 Hyde improved Robinson steerer, with the steering shaft extended forward, carried in a brass bearing stand, with a 42-inch steering wheel.

Reduced Sail Area

As dependence is to be placed on power, the former large sail areas are no longer required, and consequently the gaff was removed from the mainsail, that sail being made jib-headed with a head iron, and the bowsprit was shortened, thereby doing away with one jib. Under sail it was found that the vessel handled much better than she did previously when she was heavily ballasted, and carried the larger sail area that was necessary when she had to get off shore in a heavy gale. It was also found that the propeller offered little resistance, for as soon as the vessel got under way, getting up to a speed of four or five knots, the propeller revolves and the resistance is not noticeable.

Trials

On the trial course a speed of 9.04 knots was made with the engine turning 280 revolutions, and in service she has maintained this speed in her many runs for speaking vessels. It was found when running dead ahead the vessel steered exactly on her course and carried no helm whatsoever. In turning away from the propeller the time required to complete a circle was one and three quarter minutes, and while turning towards the wheel she took two and one-half minutes to complete the circle, swinging, however, in a shorter radius.

The engine has been somewhat of a revelation to those who have seen it working, especially as regards its reliability of reversing. It has been found possible to reverse the engine without releasing the clutch. Another point in favor of this type of engine is its complete absence of vibration or smell and the absolute safety of the kind of fuel used. The fuel is a residue from asphalt factories, known as star fuel, of from 23 to 26 degrees gravity at 60 degrees F., having a specific gravity of .9105, an open flash of 180 degrees F., a closed flash of 166 degrees F., and a burning point 235 degrees F. The characteristics of the fuel are asphaltum, 25 degrees; sulphur, ¾ percent; British thermal units, 19,200; pounds per U. S. gallon, 7.485; viscosity, about 323 at 15 degrees C. The fuel costs 90 cents (3/9) a barrel (42 gallons) in San Francisco.

The propeller was designed with a large diameter—58½ inches—and a correspondingly small surface ratio of 30 percent, so as to offer little resistance while sailing. The propeller absorbs 134 horsepower when the vessel is making 9 knots, and when driving into a head sea the engine holds up to her rated revolutions, showing that the engine has a large surplus of power.

In order to start the engine it is necessary to preheat the bulbs with the coal oil torches. The usual time required for this is from twelve to fourteen minutes, but once the engine was tried at the expiration of six minutes and it started without a hitch.

From the daily log that has been kept by the engineer since the vessel went in service, the maximum fuel used has been a little less than 8 gallons per hour under full load, and the average fuel used per hour of running is about 7 gallons. It will be seen from the above that it costs about 15 cents (0/7½) per hour for fuel to operate the *Gracie S.*

It is interesting to note that the United States Navy has bought a 50 horsepower Bolinder stationary engine to be used on the new collier *Maumee* as an auxiliary electric lighting plant, while her main engines are to be of the Diesel type.

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Electric Towing System at the Panama Locks

General Arrangement of the Locks—Method of Towing—Construction of Electric Locomotives—Safety Features

In passing through the Panama Canal from the Atlantic to the Pacific, a vessel enters the approach channel in Limon Bay, which extends to Gatun, a distance of about 7 miles. At Gatun the vessel enters a series of three locks in flight and is raised 85 feet to the level of Gatun Lake.

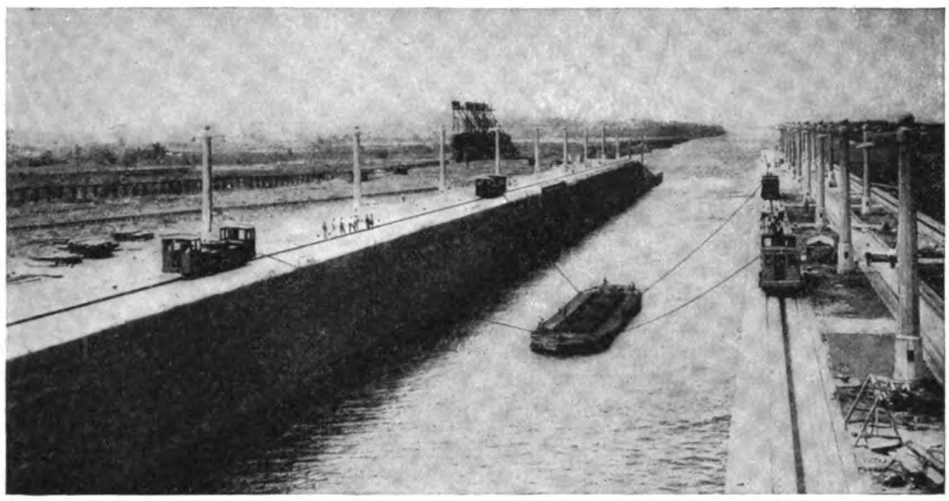

Fig. 1.—Towing Locomotives Returning Barge Through Gatun Locks to Atlantic Level

It may then steam at full speed through the channel in this lake for a distance of 24 miles, to Bas Obispo, where it enters the Culebra Cut. After passing through this cut, which has a length of nine miles, the vessel reaches Pedro Miguel, where it enters a lock and is lowered 30 feet. Then it passes through Miraflores Lake for a distance of 1½ miles until it reaches Miraflores, where it is lowered 55 feet through two locks, to the sea level, after which it passes out into the Pacific through an 8½-mile channel.

The Locks

As the main features of all the lock sites are identical, the general layout of the Gatun Locks is shown in Fig. 1. It should be noted that there are two ship channels, one for traffic in each direction, which are separated by a center wall, the total length of which is 6,330 feet. There are two systems of tracks, one for towing and the other for the return of the locomotive when returning idle. This, however, refers only to the outer walls. For the center wall there is only one return track in common for both the towing tracks. The towing tracks are naturally placed next to the channel side, and the system of towing utilizes normally not less than four locomotives running along the lock walls. Two of them are opposite each other in advance of the vessel, and two run opposite each other following the vessel, as seen in Fig. 1. The number of locomotives is, however, increased when the tonnage of the ship demands it.

Cables extend from the forward locomotives and connect with the port and starboard sides of the vessel respectively near the bow, and other cables connect the rear locomotives with the port and starboard quarters of the vessel. The lengths of the various cables are adjusted by a special winding drum on the locomotive to place the vessel substantially in mid-channel. When the leading locomotives are started, they will tow the vessel, while the trailing locomotives will follow and keep all the cables taut. By changing the lengths of the rear cables the vessel can be guided, and to stop the vessel all the locomotives are slowed down and stopped, thus bringing the rear locomotives in action to retard the ship. Therefore the vessel is always under complete control quite independent of its own power, and the danger of injury to the lock walls and gates is very greatly lessened.

Fig. 1 shows how effectively the four locomotives keep

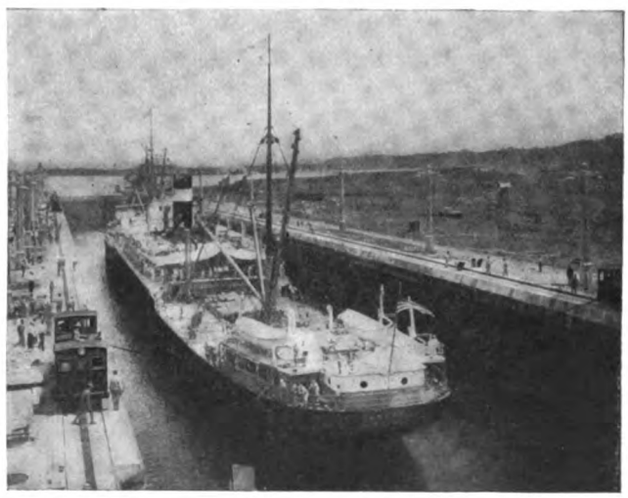

Fig. 2.—S. S. *Aucon* Entering Upper Lock Under Tow of Electric Locomotives

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the vessel under control and in the center of the channel, while Fig. 2 gives a general idea of the method of handling vessels of various sizes. The views also give an idea of the lock walls, towing tracks and the inclines, the steepness of the latter being especially noticeable. Of particular interest is Fig. 2, which represents a trial tow approaching the second level. The water in the middle lock or at this second level is at sea-level, a condition not obtained in regular operation, and this trial was made to demonstrate that the tow lines would clear the lock walls.

TOWING TRACKS

The towing tracks have a specially designed rack rail extending the entire length of the track and located centrally with respect to the running rails. It is through this rack rail that the locomotive exerts the traction necessary for propelling large ships and climbing the steep inclines.

A rack rail is also provided on short portions of the return track so as to lower the locomotives safely from one level to the next. The steepest slope is 26 degrees, or 44 percent, hence the need will be seen for a rack rail even on the return track, as any traction locomotive with the usual wheel drive, even with the brakes set, would begin to slide on a 16 percent grade and therefore could not be controlled. With a rack rail, however, traction is limited only by the capacity of the driving motors and not by the adhesion of the wheel treads on the rails.

The approach to the rack rail is hinged to the rack rail proper, so that it can be depressed on the approach of the rack pinion of the locomotive. The teeth of the approach section are under size and shaped off at the extreme end so that the teeth of the pinion will mesh properly and prevent excessive strain on the pinion and the axle. A spring restores the approach to the proper position after the locomotive has passed over. The rack rail is of the shrouded type, and each tooth space has a drain hole cast in the bottom so as to carry off water and other accumulations to suitable drain pipes or ducts set in the concrete of the walls. A further feature of the rack rail is the projecting edges, which permit thrust wheels attached to the locomotive to run along the under side and prevent overturning of the locomotive, in case some unforeseen operating condition should produce an excessive pull on the towline. These thrust wheels serve to counteract the lateral component of the towline pull and the flanges act for emergency only, as the weight of the locomotive is, however, sufficient to prevent overturning with a normal pull of 25,000 pounds on the towline.

MOTORS

Three-phase, 25-cycle, 220-volt alternating current is used for operating the locomotives, and the current is supplied through an underground contact system. Two T-rails form two legs of the three-phase circuit and the third leg is formed by the main track rails. A specially designed contact plow slides between the two "T" conductors and transmits the power from the rails to the locomotive. This contact plow also passes through the slot opening in the conduit cover and is flexibly connected to the locomotive in such a manner as to follow all irregularities in the tracks and crossovers, and therefore insures a continuous supply of power.

The locomotives are equipped with two main traction motors of the slip ring induction type, each rated at 75 horsepower and operated by a system of contactors with master controller in cabs at each end of the locomotive. The motors, by means of a change in gearing from straight traction to rack rail towing, drive the locomotive at a speed of 2 miles per hour when towing and 5 miles per hour when returning idle. These motors act as induction generators running above synchronous speed when the locomotive is passing down the steep inclines, and thereby exert a retarding brake effect to keep the speed uniform.

The towing locomotives, which have a net weight of 86,300 pounds, possess the following operating characteristics: (1) While towing, the speed can be regulated from zero miles to 2 miles per hour; (2) while running idle, the speed can be regulated from zero to 5 miles per hour, permitting return trips at increased speed; (3) the windlass will pay out or wind in cable at the low rope speed and at the full towline pull of 25,000 pounds, either when the locomotive is running or at rest; (4) the windlass will pay out or coil in cable at the high rope speed with the towline taut, either when the locomotive is running or at rest, and (5) the windlass is equipped with a safety friction device, which is adjustable to any predetermined value of the towline pull.

TRAFFIC THROUGH THE CANAL

During the first three months of commercial operation of the Canal, from August 15 to November 15, 1914, the cargo transported through the Canal and towed through the locks by the locomotives amounted to 1,079,521 tons. During the fiscal year ending June 30, 1914, the Panama Railroad carried 643,178 tons of through freight between the two seaboards, and in the preceding fiscal year 594,040 tons. From this it is seen that between six and seven times as much cargo is passing over the Isthmus now as passed over this route when goods were transshipped by rail.

The towing system described above was designed and patented by Mr. Edward Schildhauer, electrical and mechanical engineer of the Isthmian Canal Commission, and the forty towing locomotives and all the electrical apparatus for operating the locks were built by the General Electric Company, Schenectady, N. Y.

Institution of Naval Architects

At the annual meeting of the Institution of Naval Architects, held in the Hall of the Royal Society of Arts, John street, Adelphi, London, on March 24 and 25, the following papers were read and discussed:

The Watertight Subdivision of Ships. By Professor J. J. Welch, M. Sc.

The Increase of Safety Afforded by a Watertight Deck. By Kenneth G. Finlay.

The Influence of Discharging Appliances on the Design of Large Ore-Carriers. By John Reid.

The Scantlings of Light Superstructures. By J. Montgomerie, B. Sc.

On the Strength and Spacing of Transverse Frames. By C. Frodsham Holt, B. Eng.

A Contribution to the Theory of Propulsion and the Screw Propeller. By F. W. Lanchester.

A Comparison Between the Results of Propeller Experiments in Air and Water. By A. W. Johns, R. C. N. C.

Further Model Experiments on the Resistance of Mercantile Ship Forms: The Influence of Length and Prismatic Coefficients on the Resistance of Ships. By J. L. Kent.

The Law of Fatigue Applied to Crankshaft Failures. By C. E. Stromeyer.

The Effect of Beam on the Speed of Hydro-Aeroplanes. By Linton Hope.

Notes on the Cross Curves and GZ Curves of Stability. By E. F. Spanner, R. C. N. C.

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Introduction of a Modern Method in Shipbuilding

BY WILLIAM BROWN *

In shipyards years ago the bent frames and floor plates for a ship were carried in their raw state to the scribe board so that they could be laid out for punching. After these slow and expensive operations all other work was templated from the ship. Present-day practices in shipyards, however, demand that 95 percent of all structural work be developed from the scribe board. But in spite of the enormous strides that have been made in this industry in the last third of a century, no shipbuilder can successfully deny that many operations are still distressingly slow and expensive, and entirely out of harmony with even the rudiments of scientific management. In fact, many operations in present-day development of structural work on ships could be carried on much more economically and expeditiously under the system of years ago.

This statement may sound strange and somewhat contradictory, but it is none the less true. For instance, under the present system a bulkhead, say, is laid down on paper in the mold loft, and then the paper is transferred to the plates for laying off, plate by plate. The old way was to place the bulkhead plates in their respective positions and lay them off direct, thus obviating the expense of making templates. Not only did this apply to bulkheads, but to sections of decks, bottom and side plating, and inner bottoms. It must be said, however, that such procedure required considerable space in the yard for laying off purposes.

What is wanted is a system that will eliminate the waste of time and money of past and present methods. But the accomplishment of this happy medium is a task that has baffled many shrewd investigators in this field of endeavor.

Naturally, the first question that suggests itself is, Where shall the start be made? We must look for our answer in the drawing room. It is there that the old customs survive, and the sooner that this branch abandons some of its archaic customs, the sooner will the quickened pulse be felt in the shipyard proper. What happens at present? When the model arrives the draftsman takes it in hand to line it up in exactly the same manner as he did years ago. His one aim and ambition in life seems to be to develop beautiful lines showing the plate edges, apparently for no other reason than because somebody started a job that way in the dim, distant past. Of course, every practical shipbuilder fully realizes the necessity of having good and fair plate edges, but at the same time the employer should justly receive a little consideration while those same beautiful lines are being developed. Reference here is not made to shell plating only; the same remarks apply to decks, bulkheads, inner bottoms, outer bottoms, and inner and outer keel plates.

Under the method here proposed let us accompany the model to the drafting room and begin by giving the draftsman his orders as to the development of the lines. Fair lines are wanted, of course, but why not instruct him to lay out as many rectangular plates of the same width and length as possible? Length is really not so necessary as width, as the former dimension can readily be obtained without change of design. The number of rectangular plates that can be obtained from a ship's bottom, side plating, decks and bulkheads, will afford much surprise to those who have not given the matter special consider-

* Master Shipfitter, League Island Navy Yard, Philadelphia, Pa.

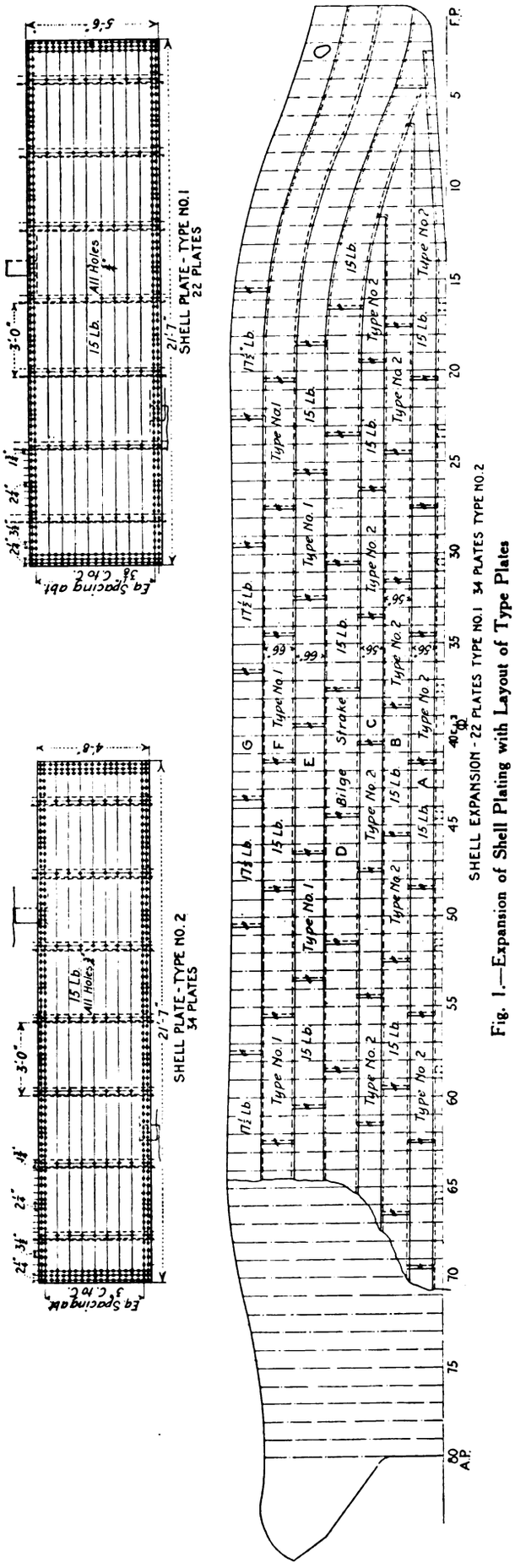

Fig. 1.—Expansion of Shell Plating with Layout of Type Plates

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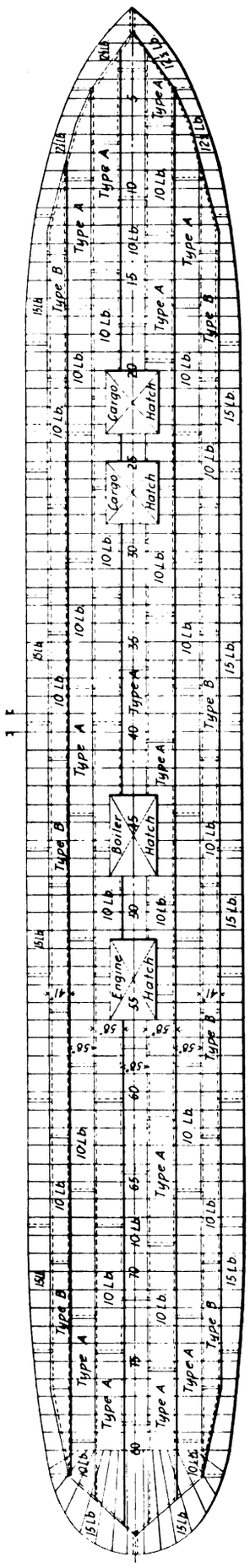

Fig. 2.—Deck Plating Plan. 32 Plates Type A. 16 Plates Type B

ation. Figs. 1, 2 and 3 give a rough but approximate idea of what can be accomplished in this direction.

Criticism will aptly show, of course, that the figures indicate a ship with long, flat sides and bottom. It is needless to point out that the system proposed is not applicable to every ship, for such a contention could not be borne out, but it is stoutly maintained that the procedure here outlined is well adapted to a high percentage of shipbuilding work.

Size type plates as shown in Figs. 1, 2 and 3 will be ordered by the draftsman, and no shearing will be required. Emphasis can here again be laid on the expensive methods employed at present. In most shipyards the templates for all plates are developed in the mold loft, after which they are passed to the shipfitter for laying

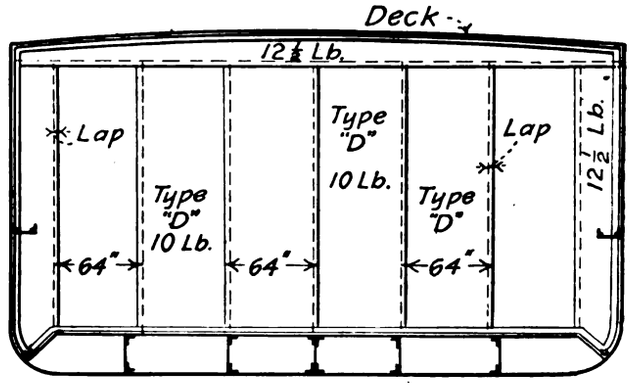

Fig. 3.—Bulkhead Plan—6 Plates Type D

out. The plates having been laid out, are taken to a punch, and after punching they are sheared. An average of 2,500 to 3,000 holes by one punching gang is considered a good day's work.

Now, let us see what happens to the type plates as shown in Figs. 1, 2 and 3. First of all, there must be introduced into shipbuilding a machine known as an automatic spacing table with multiple punch, equipped with gag control mechanism. The machine is designed primarily for plate punching, but with equal facility it can be used for punching any straight angle work. Instead, however, of the 2,500 to 3,000 holes a day punched by a gang under the old methods, this machine has the astonishingly large output of 60,000 to 80,000 holes a day depending entirely on how often a change is necessary in the gag control to suit the different sizes of plates. This, too, is accomplished with no increase in the labor necessary under the old, cumbersome methods previously described.

This result is made possible because no template for the plate is required. The plate is not laid off at all; it enters the machine in its raw state exactly as it comes from the mill. The spacing table is regulated by one strip of template wood about ⅝ inch by 2½ inches, in sections corresponding to the actual length of the plate to be punched, and this is laid out from the plan either in the drawing room or in the mold loft. The details of setting up the spacing table and gag control are very simple, requiring no mechanical ability. The spacing table removes all guesswork, there is no contraction or expansion of paper templates, and all that is required is the small strip of wood just referred to. Not only will the use of the methods here outlined result in great economy in punching, but it will effect corresponding economies by eliminating making templates and marking plates.

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Mention was made of the automatic control of the machine here described, applying particularly to where a large number of duplicate parts are required. This feature relieves the operator from the necessity of devoting any of his time to the gags and effectually eliminates the possibility of error. On ship work, however, on account of the frequent changes necessary, the gag can be controlled by hand levers, and to avoid the possibility of error a signaling system is used to indicate the point where important changes occur.

The accuracy of spacing obtained on a machine of this type was strikingly demonstrated in the case of eleven plates 60½ inches wide, 9/16 inch thick and 21 feet long. Holes 15/16 inch in diameter were punched in each one of the eleven plates, and when the plates were brought evenly together, face to face, a ⅞-inch bolt was loosely inserted in every deep hole caused by the individual punchings.

Notes on the Conversion of Cargo Vessels into Bulk Oil Carriers

BY F. K. RUPRECHT *

At times the demand for boats of a certain type for special cargoes exceeds the supply. This demand is of a temporary nature and in some cases would be all over by the time a fleet of new vessels could be constructed for this special purpose. Often the need is not so great as to warrant the construction of a fleet, and it is then that the owner looks toward conversion.

Conversion from one type of vessel to another for special purposes is not an old idea in shipbuilding, for, since the real type vessel is a recent invention, so also is conversion. From a structural viewpoint the conversion of vessels into bulk oil carriers is probably the most difficult and interesting problem in shipbuilding.

Some time ago a greater oil-carrying tonnage was demanded by a sudden increase in trade. The shipyards were all busy and behind time with contracts for this type of vessel. This condition forced the transportation companies to turn to conversion. The idea was not hailed with delight, because it is not a cheap job to convert a general cargo boat into a tank ship.

Strength of the Vessel

The first requirement in a convertible vessel is strength. Some ships, while having ample strength for their trades, have not that extra degree required for bulk oil carriers. Oil is a "dead" cargo, and so causes extra stresses in the hull. In a seaway the oil gets into motion and the stresses caused by it are of a nature unknown to the general cargo vessel. Besides being strong the hull must be in an especially well preserved condition. It is easy to see what a great expense it would be to try to fit new oiltight work on old work in poor condition. It would be practically impossible to fit an oiltight deck on corroded beams or to fit a bulkhead on unfair or corroded plating.

The type of vessel must also be suitable for conversion. A large single-deck vessel, for instance, would be very expensive to convert, because she could not carry herself full and so an extra deck would have to be added to limit the size of the oil tank and provide an expansion trunk. In a three island vessel, one with a long bridge or poop deck would also involve extra construction, for the long erections would have to be replaced by smaller ones to keep them clear of the expansion trunk hatches and pump-room entrances. A complete shelter or spar deck vessel involves the least difficulty, providing she has two complete decks besides—i. e., main and upper decks. A three or a two deck vessel involves the least extra construction. If there are not two complete decks, the problem of a proper expansion trunk becomes difficult, because no vessel could carry oil up to the upper deck and then the expansion truck above that. We thus see that the number of convertible ships is not as large as might be imagined, because only a modern high-grade type of vessel would be worth the cost of conversion.

Another question that has to be dealt with in conversion is whether the boat is to be an oil carrier permanently or only for a period of a few years. The consideration of this problem involves the question of structural design and general arrangement. The new work must be designed so as to offer the least interference to subsequential use of the vessel in the general cargo trade, or so that it can be changed for the purpose to a greater or less degree at a reasonable expense. This applies more directly to hatches, expansion trunks and access to the smaller compartments, due to subdivision. In the earliest conversion jobs the owners seemed to be doubtful of success, and so found it advantageous to burn as few of their bridges behind them as possible. Needless to say, the jobs were successful, but now they have boats that can easily be sent back to their old trade without too great a loss of space or money.

Location of the Machinery

The location of the machinery is another question of importance. The modern tanker has her engines and boilers aft of all oil tanks and pump rooms, but very few convertible vessels will be found with their machinery anywhere but amidships. This arrangement involves extra expense and weight of steel work, for we have to provide four complete cofferdams and two pump rooms, as against two of the former and one of the latter in the type of vessel with her machinery aft. If internal combustion engines were the rule, one of the two pump rooms could be done away with by passing the oil lines through the engine room in an oiltight, well-ventilated tunnel.

The following remarks deal mostly with a type of vessel with her engines and boilers amidships. In this case we have a more difficult problem, and all the principles involved can be applied to the other type of vessel.

The first thing to be considered is the proposed general arrangement of the vessel. This is more or less a problem of the location of transverse bulkheads. The different registration societies, such as Lloyds and Bureau Veritas, limit the length of the oil tanks to between 24 and 28 feet. The object of this is to prevent the oil from getting so much momentum when the ship is pitching as to break down the bulkheads. The foremost end of the forward cofferdam is fixed, insomuch as the crew quarters must be forward of this bulkhead. If desired, this space may be reduced by one or two frame spaces in order to give a better arrangement of bulkheads.

If the crew is not housed forward, the location of the foremost bulkhead will be fixed with regard to a dry hold aft of the chain locker and fore peak and forward of the cofferdam. This space is used for general cargo or ship's stores, and will usually be about six frame spaces in length. Aft of this will be a two-frame space cofferdam, aft of which will be the oil cargo tanks. The space available for these tanks will depend on several conditions. If the vessel is a coal burner, ample space must be provided

*Associate Member Society of Naval Architects and Marine Engineers.

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for a cross bunker. Coal may be also carried in the 'tween deck bunkers alongside of the engine and boiler spaces, as well as alongside the expansion trunks, or in some cases in the shelter 'tween decks outside of the gastight trunks around the hatches.

In certain trades all possible space must be given up to coal and this condition will decide the design. In some cases ample coal may be carried in the 'tween deck bunkers alongside the boiler and engine room spaces and the cross bunker. Then the space alongside the expansion trunk could be converted into summer cargo tanks.

PUMP ROOM

Beside the cross bunker we must have space for another cofferdam forward of it and for a pump room. These two may be combined—that is, make the cofferdam large enough to hold the pump room and be a one-frame space cofferdam besides. Five or six frame spaces will, as a rule, be ample room for this. Another arrangement that can be adopted is to have only the required two-frame space cofferdam and have a pump room in the aftermost oil tank of about four or five frame spaces. This arrangement gives a smaller carrying capacity and the pump room is more liable to be flooded, because two of its sides are formed by main cargo bulkheads. However, this method is used in almost all of the modern tank ships, and with good workmanship seems to give no trouble. In the former arrangement the one-frame space cofferdam may come between the oil tank and pump room or between the pump room and the cross bunker. The former arrangement is preferred, because the pump room is less liable to be flooded and greater safety in case of fire is secured. The pump room will not extend the total width of the vessel, but only to the centerline bulkhead. The floor may be laid on the tank top or may be of the suspended type. The forward and after pump rooms will be arranged on opposite sides of the centerline bulkhead, and the weights of the structure and the water ballast will be balanced in this way.

FUEL OIL BUNKER

If the vessel is fitted, or is to be fitted, for oil fuel, the foremost and aftermost cofferdams may be used for bunkers. The space mentioned above for the cross coal bunker may be used for the fuel, and, if considered necessary, a cofferdam may be fitted between the bunker and the boiler room, as well as one between the cargo and the fuel tank. The latter cofferdam may be dispensed with if the ordinary pump room is installed. In this case the centerline bulkhead will be carried through the fuel bunker.

The arrangement of cofferdams and pump room aft of the engine room would be similar to the forward ones except that no coal or fuel bunker need be provided. Aft of the aftermost cofferdam a dry hold should be provided for access to the shaft tunnel and to provide, if possible, means for getting in or out the spare tail shaft. A fair size hatch should give access to this hold, as well as a smaller trunk with a booby hatch on the weather deck for access to the tunnel.

Having found the space available for oil tanks it is best to divide it up equally into the desired number of tanks. The question of trim in the loaded and ballast conditions should be looked into and the length of the foremost and the aftermost tanks made so as to give the desired effect.

In designing the expansion trunk the width is the only variable, because the height will be the height of the 'tween decks. The width will have to be fixed by considering the carrying capacity of the vessel and should be such as to bring the vessel to her load waterline when about three-quarters full. The width must not, however, exceed sixty percent of the beam of the vessel. The trunk bulkheads will be continuous through the cofferdams, although in the latter they need not be oiltight.

(To be continued.)

Two New Crandall Railway Dry Docks

Two railway dry docks have recently been completed by the Crandall Engineering Company, East Boston, Mass., one in the harbor of Havana, Cuba, and the other at the Port of Selkirk, Manitoba, on the Red River of the North near its entrance to the southern end of Lake Winnipeg. The first of these was built for the Havana Marine Railways, Inc., an American Company, which has installed a ship repair plant at that port. The other dock was built for the Department of Public Works of the Canadian Government, which maintains a repair depot at Selkirk for its dredges and other building equipment. It is interesting to note that the Crandall Engineering Company, who designed and constructed these docks, have built about a hundred railway dry docks of this type in various parts of the world, many of which have been illustrated in previous issues of this journal.

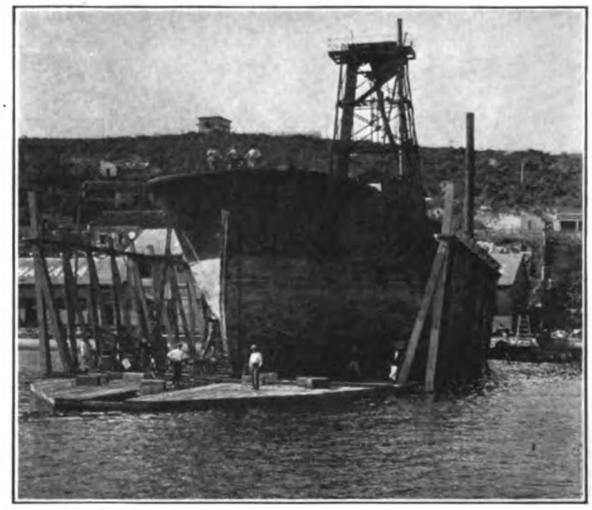

Fig. 1.—Crandall Dock at Havana

The new dry dock at Havana is 260 feet long over keel blocks, 280 feet long over the floor, 60 feet wide with 12 feet of water over the keel blocks forward and 17 feet aft. The capacity of the dock is 2,200 tons, and with quadruple hauling chains which are operated by steam hoisting machinery, a vessel of the full capacity of the dock can be hauled out within the short space of 18 minutes after being centered and blocked.

The dock is constructed of timber protected against the action of toredo, except such parts as are permanently above water, the latter being of reinforced concrete. The foundation is piling driven to bedrock. Patent releasing bilge blocks are provided and the carriage travels upon a three-way track on the free roller system.

Construction of this dock was begun in January, 1914, and completed in September after considerable delay owing to cancelling of concessions by the Cuban Government, which tied up all dredging operations in the harbor. Besides the dry dock, however, the company installed machine, plate, boiler and smith shops equipped with first class modern tools, and has provided for future exten-

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sions in this line. It will undoubtedly be a relief to many ship masters and owners to know that there is an up-to-date repair plant at Havana under American management.

The dry dock at Selkirk is of 1,500 tons capacity, 192 feet long on the keel blocks, 212 feet long over the floor, 52 feet wide, and at ordinary summer levels has a draft of 11 feet over the keel blocks forward and 15 feet aft. Electric power is used in this case in operating the dock, and a full load of 1,500 tons may be hauled out in fourteen minutes after being blocked.

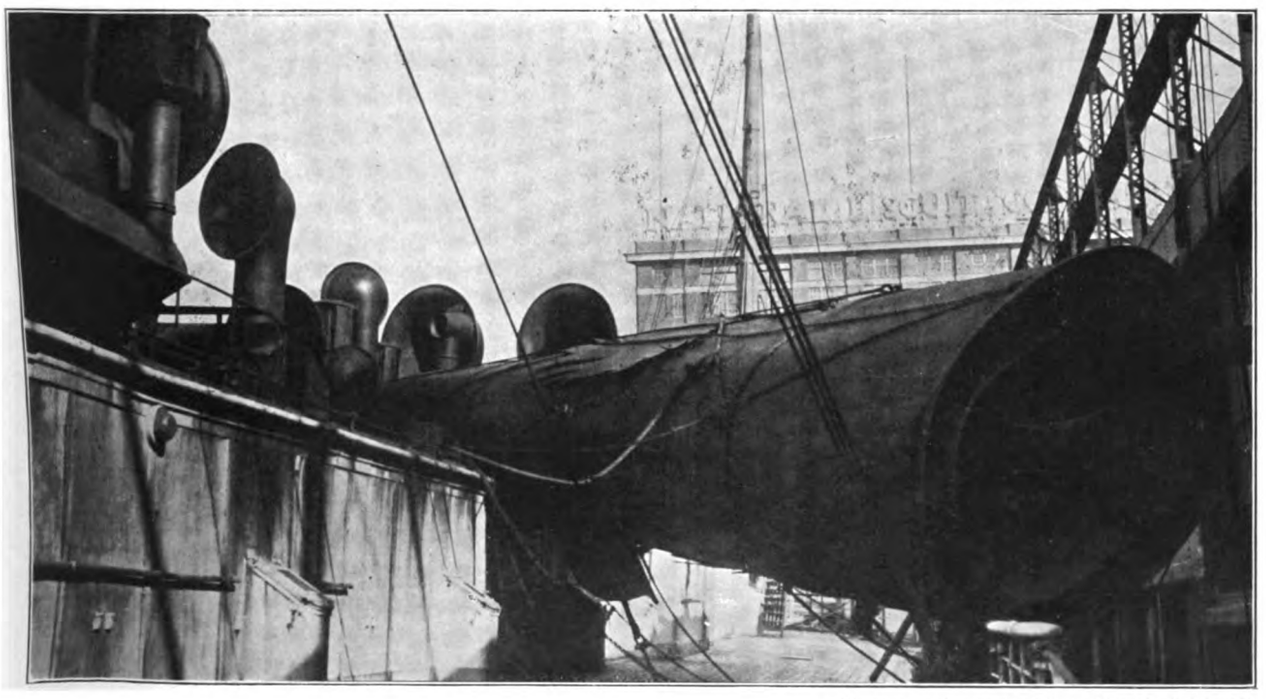
Fig. 2.—Crandall Railway Drydock at Selkirk, Manitoba

The carriage is built in two sections, the upper being entirely open on one side to allow boats to be tracked to the yard. It is so designed that at a later date a transfer cradle may be fitted to move vessels from the cradle to the yard. The carriage is of composite construction, the main frame being of fabricated steel and the balance of wood.

There are three tracks of timber resting on a foundation of piling. In order to obtain the required length and keep clear of the main ship channel, it was necessary to cut back into the river bank. The sides of the cut are held up by concrete retaining walls on a pile foundation.

The contract for this dock was signed early in 1914, but, owing to the fact that the ground in this part of the country freezes to a depth of 6 to 7 feet in the winter, it was impossible to begin excavation until the latter part of May. The work was completed, however, early in October, and the dock was tested successfully on November 5.

STORM DAMAGES FRENCH LINER GASCOGNE.—During a northeast gale which raged in mid-Atlantic from March 7 to 9, the French liner *Gascogne*, bound from Havre to New York, was seriously damaged. Heavy seas tore away the deck rails, swept away the forward funnel a few feet above the deck and loosened the aft funnel, threatening at times to swamp the vessel. The ravages of the storm can be seen from the photograph shown below.



(Photograph Reproduced from New York Herald)

Deck of French Liner *Gascogne*, Showing Forward Funnel Wrecked by Storm

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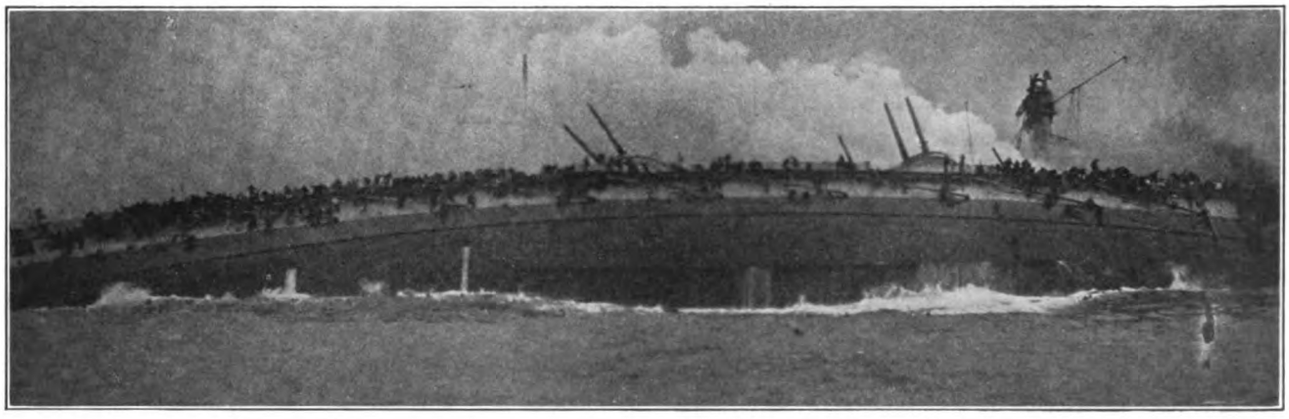

(*Photograph Copyright by London Daily Mail*)

German Armored Cruiser *Bluecher* (15,500 Tons, 32,000 Horsepower, Armed with Twelve 8.2-Inch and Eight 6-Inch Guns) Foundering After Having Been Shelled and Torpedoed in Running Fight Between British and German Squadrons in the North Sea

The Latest French Destroyers

Among the latest additions to the French Navy are the four destroyers *Aventurier, Opiniatre, Temeraire* and *Intrepide*, which are the largest vessels of their type now under the French flag. All of these destroyers were built and engined by the "Britany yard" at Nantes. Their main particulars are: Length overall, 283 feet; beam, 28.32 feet; depth, 17 feet; draft, at the stern, 10 feet; displacement, 1,100 tons.

The type of hull is the same as adopted in the previous destroyers *Voltigeur, Fourche*, etc., which have been illustrated and described in previous issues of this journal. This type of design, however, has proved very efficient, allowing the propellers to give their maximum efficiency even in bad weather. Their seaworthiness has been amply proved in actual service during the winter months.

The engines consist of two Rateau turbines, each driving a propeller 7 feet 3 inches diameter and 6 feet 9 inches pitch, working at 650 revolutions per minute. The total horsepower developed is about 20,000, and it is reported that speeds of 32 knots were obtained on the measured mile trials. Steam is supplied by four water-tube boilers, using coal as fuel, and a fifth fired with oil fuel. The capacity of the coal bunkers is 12,362 cubic feet and of the oil tanks 3,179 cubic feet. The destroyers have an acting radius of about 3,000 miles.

The armament consists of four 4-inch rapid fire guns, all mounted on the centerline of the vessel, and four 18-inch torpedo tubes.

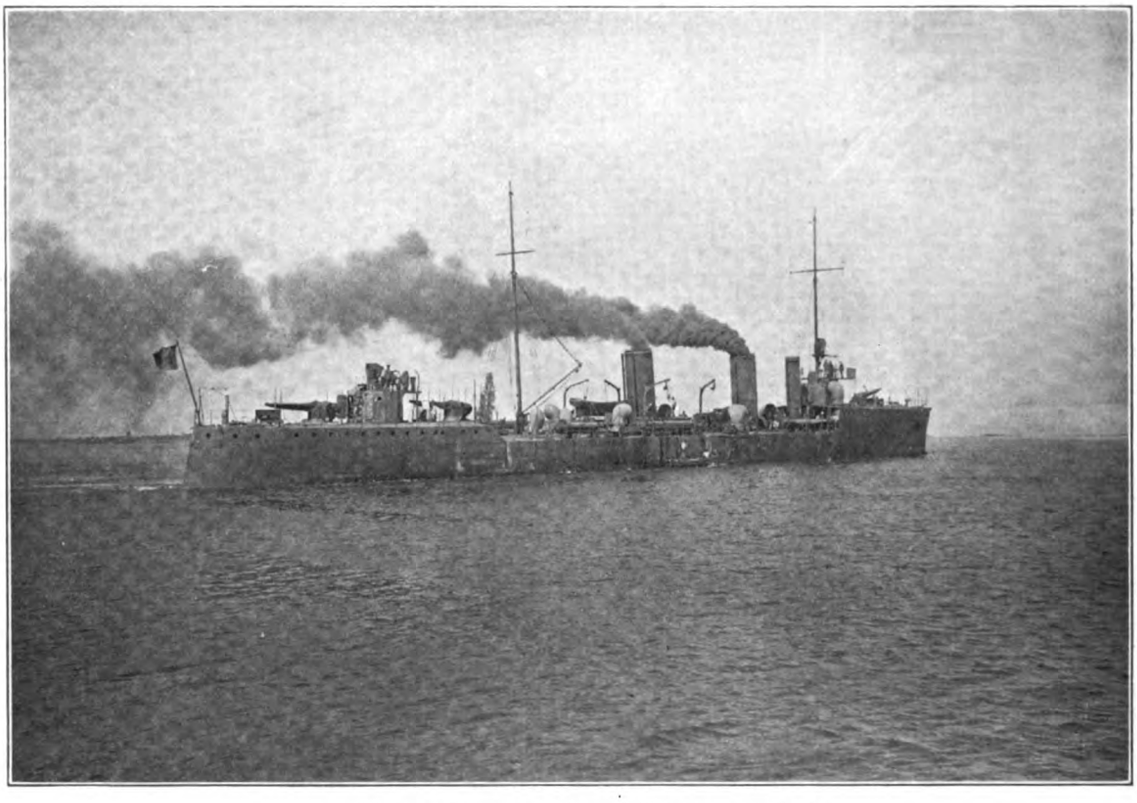

Fig. 1.—One of the New French Destroyers on Trial

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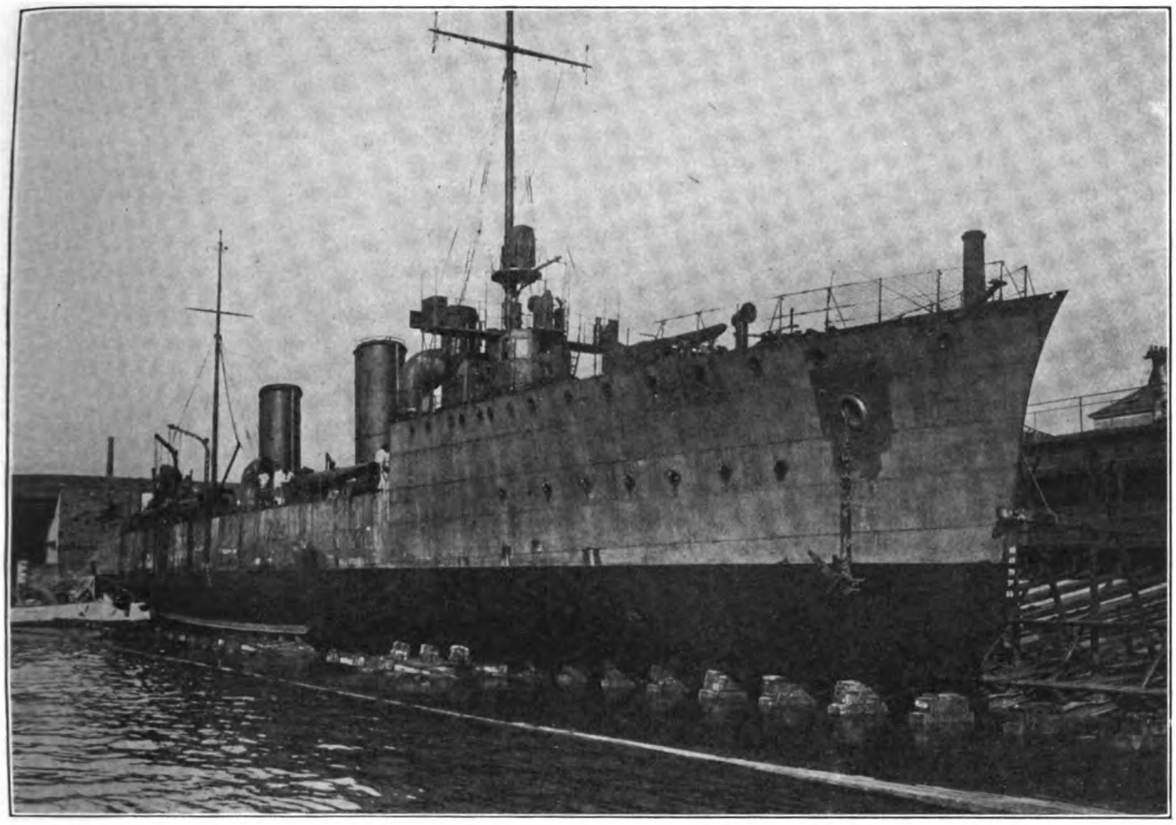

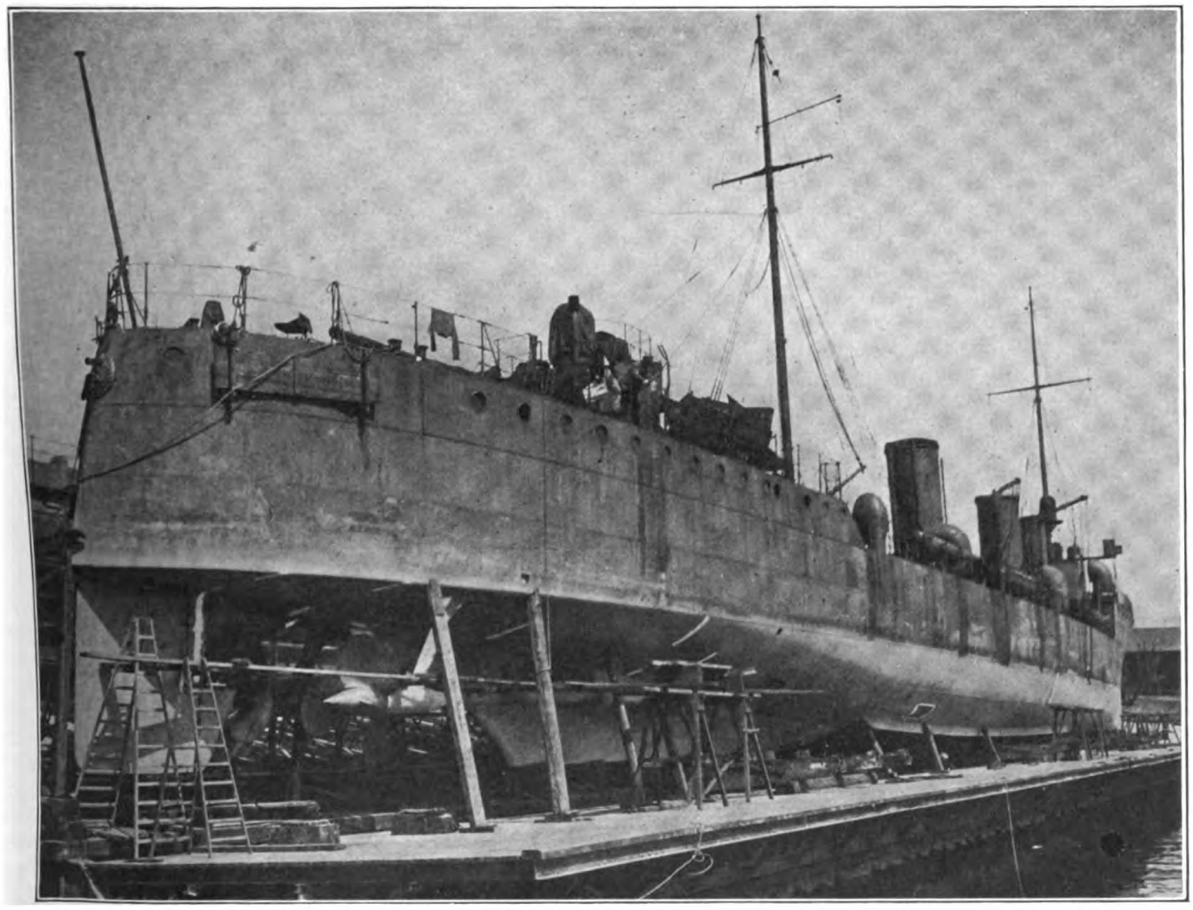

Figs. 2 and 3.—Bow and Stern Views of 1,100-Ton French Destroyer

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Output of Japanese Shipyards in 1914

The total output of Japanese shipyards in 1914 amounted to 136,310 gross tons. Nearly 82 percent of this tonnage, or 111,343 gross tons, consisted of 18 steamers, all of which were above 1,000 tons. Of the vessels under 1,000 tons, 61, aggregating 14,297 gross tons, were coasting steamers and tugs, and 80, aggregating 10,670 gross tons, were sailing ships.

The particulars of the 18 steamers above 1,000 tons are as follows:

Names	Type	Gross Tons	I. H. P.	Built at
H. M. S. *Fuso*	Battleship	30,600 (Displ.)	40,000	Kure Naval Dockyard
Fushimi Maru	T. S. Pass. & Cargo	11,757	12,000	Mitsu Bishi Dockyard
Suwa Maru	T. S. Pass. & Cargo	11,757	11,211	Mitsu Bishi Dockyard
Yasaka Maru	T. S. Pass. & Cargo	11,813	10,415	Kawasaki Dockyard
Toyooka Maru	T. S. Cargo	7,630	5,800	Mitsu Bishi Dockyard
Toyohashi Maru	T. S. Cargo	7,500	6,000	Kawasaki Dockyard
Tokuyama Maru	T. S. Cargo	7,500	6,000	Kawasaki Dockyard
Harbin Maru	T. S. Pass. & Cargo	5,500	6,500	Kawasaki Dockyard
Peking Maru	S. S. Cargo	3,181	1,648	Osaka Iron Works
Nanking Maru	S. S. Cargo	3,181	1,824	Osaka Iron Works
Chokyu Maru	S. S. Cargo	2,138	1,150	Uraga Dock Company
Hosan Maru	S. S. Cargo	1,194	833	Osaka Iron Works
Isshin Maru	S. S. Cargo	1,484	1,114	Osaka Iron Works
Naha Maru	S. S. Cargo & Pass.	1,040	1,000	Fujinagata Shipyard
Hakushin Maru	S. S. Cargo	1,536	1,272	Mitsu Bishi Dockyard
Yaeyama Maru	S. S. Pass. & Cargo	1,036	953	Mitsu Bishi Dockyard
Miyako Maru	S. S. Pass. & Cargo	1,013	981	Osaka Iron Works
Michi Maru	S. S. Cargo	1,483	764	Tochiki Shipyard
	Total	111,343	124,297	

The most interesting vessel built in 1914 was the battleship *Fuso*, of 30,600 tons displacement, which was launched at the building dock at Kure in March, 1914. This vessel, which is one of the largest and most powerful battleships afloat, carries twelve 14-inch guns in six turrets, all arranged on the centerline of the ship. The vessel will go into commission during the latter part of next year.

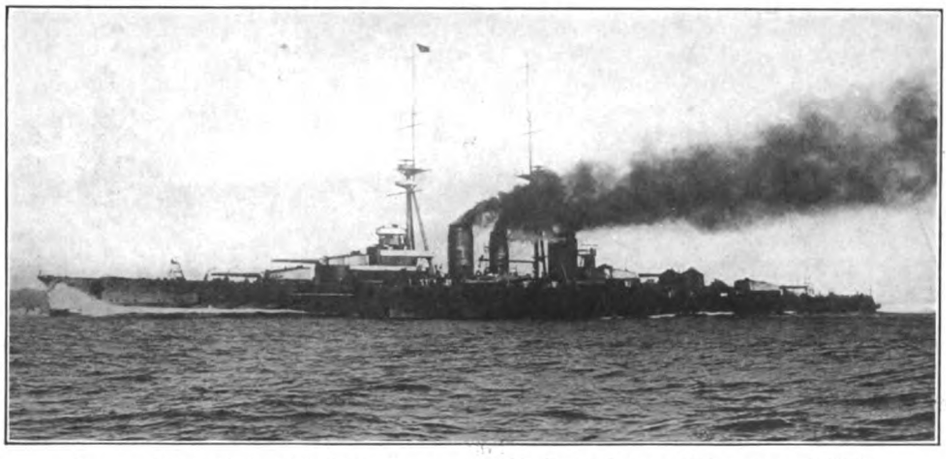
In addition to the *Fuso* there are under construction three sister ships, namely the *Yamashiro*, at the Yokosuka Navy Yard, the *Hiuga* at the Mitsu Bishi Dockyard at Nagasaki, and the *Ise* of the Kawasaki Dockyard of Kobe. The propelling machinery of these ships consists of Brown-Curtis turbines and Japanese Admiralty type watertube boilers, with the exception of the *Hiuga*, which is fitted with Parsons turbines. The battle cruiser *Hiyei* was completed last summer and is now engaged in actual service, while her two sister ships, the *Kirishima* and *Haruna*, are now undergoing speed trials at the Mitsu Bishi Dockyard and the Kawasaki Dockyard, respectively.

After the outbreak of the present war, a supplementary budget was passed in the special session of the Diet, held last September, authorizing the construction of ten destroyers of 600 tons displacement and 9,500 indicated horsepower, to be completed in about six months. Contracts for the construction of two of these vessels were placed with the Mitsu Bishi Dockyard, two with the Kawasaki Dockyard, and one each with the Osaka Iron Works and the Uraga Dock Company. The hulls, machinery and equipment of these vessels will be constructed entirely in Japan.

The output of merchant vessels included three 12,000-ton liners, named the *Fushimi Maru*, *Suwa Maru* and *Yasaka Maru*; three 7,500-ton cargo steamers, one being fitted with geared turbines of 5,800 indicated horsepower; a 5,500-ton passenger steamer, and two cargo steamers of 3,200 tons each, built on the Isherwood system of longitudinal framing. A number of coasting steamers were also launched and there has been considerable activity in building small craft throughout the country.

As regards the new work now in hand, there are two 10,000-ton steamers, one 7,500-ton steamer and many smaller vessels on the stocks at the principal shipyards. There is, however, little prospect for new orders in the immediate future.

The building of steam trawlers, which was once a very prosperous business in Japan, has practically ceased, owing to the over-production of this type of craft and the gradual decrease in the earning capacity of the fishing industry. On the other hand, however, the adoption of oil motors in small fishing vessels is progressing steadily, there being at present about 3,000 motor fishing vessels scattered throughout Japan. In this way the construction of marine motors has become one of the most important features of the marine engineering industry in Japan.



Japanese Battle Cruiser *Hiyei*; Displacement, 27,500 Tons; Indicated Horsepower, 64,000

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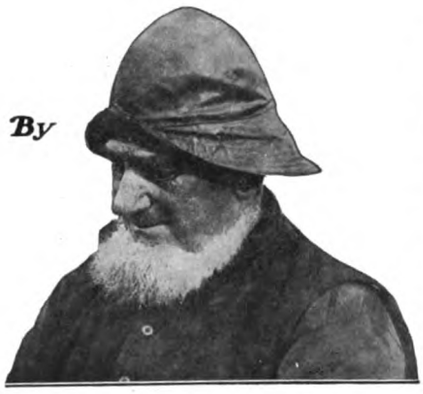
Economy Talks By "Old Scotch"



Feed Water Heaters and Boiler Circulators

Well, Sir! here I've been talking about how to save in small things on board ship these hard times, and, much to my surprise, and almost disgust, I went aboard two good-sized tugboats right here in New York harbor that didn't have a sign of a feed-water heater on board either of them. I could hardly believe my eyes, and when I asked the chief engineer of one of them why he didn't have such a contraption, he simply shrugged his shoulders and said, "Damfino." I don't know who the superintending engineer was, but his company must either have money to burn, or else they ought to get a new boss engineer.

Of all the ways of saving money right off quick, I don't know of any that is more positive on any kind of a steam vessel, large or small, than an ordinary feed-water heater. By using some of the exhaust steam to heat the feed-water, it's a cinch that you can save at least ten percent of your fuel bills. Besides that, it is simply downright cruelty to boilers to pump in feed-water that isn't heated up to much over 90 or 100 degrees. If you had a pair of horses working for you, and kept filling them up with ice water, you wouldn't expect to get very much work out of them. They might get along for a time, but sooner or later they would get cramps and lay down on the job. Marine boilers get the next thing to cramps when filled with cold water, and express their indignation at such treatment by starting to leak in all their joints.

When you consider that you will save enough fuel in six months on any kind of a job to pay for the installation of a feed-water heater, isn't it a surprising thing that some engineers, even to this day, will refuse to have them put in? I can remember well when these fuel-savers were first put on the market, and it wasn't such a long time ago, either. Like a great many others, I held back about adopting the new-fangled idea, but "Lordy Me!" when I looked into the matter seriously and saw what they would accomplish, I wasn't long in getting on the band wagon and having one installed on my packet. Now, of course, I am like all other converts to anything new, and wonder how anyone can be so stupid as to go without a heater.

Taking it all in all, I believe we marine engineers are about the most conservative bunch of ducks that ever was, anyhow. The great majority of us have now been won over to using feed-water heaters, but there is another apparatus which accomplishes about as good results, that the most of us are still as shy of as a jack-rabbit is of a hound dog. What I have in mind is a good circulating apparatus to warm up the water under the furnaces of our Scotch boilers.

If you hired a man to work for you, and had his head and body wrapped in a warm blanket, while his feet and legs, up to his knees, were standing in ice water, you wouldn't reasonably expect to get very efficient work out of him. Yet we all have been doing practically that same thing with our boilers all our lives.

We have all looked disgusted when the belly seams started to leak and said, "Well, that is one of the worst features of the shell boiler," and never for a moment have considered that it was easy to remedy such conditions. Lately, however, several live wires have patented devices which will keep the water under the furnaces circulating like the water above the furnaces, and even then we stand shy of them. It is only when some of them come along, take us by the back of the neck and absolutely guarantee results, that we will consent to give them a trial. Our own good sense ought to tell us that the temperature can be raised in the bottom of the boiler to practically the temperature of the steam, and we shouldn't need any guarantees. But then we are so timid and shy of new inventions that we have to be coaxed to try one of this particular kind.

Just think what is to be gained by this improved circulation! The shell plates, being heated up uniformly all around the circumference, will forget to leak, the boiler itself will, in nine times out of ten, forget to lift its water, and there is bound to be a small saving in fuel—not very much, but sufficient to make it worth while from that standpoint alone.

A friend of mine, about ten years ago, had a pair of old boilers under his charge which were ticketed to be replaced right off on account of their leaky condition. The company, however, couldn't raise the price just then, so as a sort of a last resort, like trying any old kind of dope on a dying man, they decided to try one of these circulating devices they saw advertised. The result is that the old kettles are still in use, and my friend writes me that they are steaming as well or better now than they ever did in their lives. Of course, boiler builders can't be expected to recommend devices that will keep their work from wearing out and getting along without any repairs, but then the shipowners ought to have a look in occasionally during these hard times.

When we get to using apparatus of this kind, as we all are bound to do, if we have any sense left, then we ought to do another thing that has always struck me funny as to why it isn't always done. That is, to cover the bottoms of the boilers with lagging, the same as the tops. Isn't it foolish, when you think of it, that we haven't done so before? The best reason I could ever think of for not doing so, was that it makes the boilers really and truly Scotch—that is, to clothe their bodies and let their legs go bare.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT*

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Q.—I understand that fuses are usually labeled for their working load. Can you tell me about how much of an overload it takes to cause them to blow out? L. L.

A.—Fuses are rated at 80 percent of their capacity, so that an overload of 25 percent will cause them to burn out.

Q.—Can you give me the composition of a good Babbit metal suitable for use in marine engine bearings? M. T.

A.—United States Navy specifications require the following: Copper, 3.7 percent; tin, 88.8 percent, and 7.5 percent of the regulus of antimony, all to be fluxed with borax and rosin in the mixing.

Q.—What are considered reasonable steam consumptions for modern triple-expansion engines as are common in merchant ships? What is good for a boiler feed pump? E. McL.

A.—Fifteen pounds per horsepower per hour is a commonly accepted standard for triple expansion marine engines of fair size and operating condensing. Many, however, will better this figure by 10 percent or more. For boiler feed pumps of the reciprocating direct acting type and of good design and construction the steam consumption should be from 1¼ percent to 2 percent of the water pumped for pumps operating at from 200 to 300 pounds per square inch.

Q.—Will you kindly tell me if centrifugal pumps are ever used for boiler feed pumps, and if so, whether it is possible to use them on boilers having pressures as high as 245 pounds? C. P.

A.—Centrifugal pumps of the multi-stage type are now commonly used for feed pumps, and no trouble has been experienced for pressures up to 250 pounds, or even greater. They are usually of from two to four stages and may be motor or turbine driven. The compounding practically consists of connecting several single stage pumps in series, each pump or stage raising the pressure through a moderate range.

Q.—Will you please inform me what the temperature of a smokestack is at forced draft, induced draft and natural draft? J. N.

A.—Theoretically, the best natural chimney draft occurs when the absolute temperature of the hot gases is 25/12th of that of the surrounding air. If the air were at 60 degrees Fahrenheit then the temperature would be $(60 + 460) \times 25/12 = 1{,}085$ degrees absolute, or 625 degrees Fahrenheit. In general, for natural draft, 600 to 700 degrees Fahrenheit are common temperatures. Lower temperatures can be obtained with induced and forced drafts unless the boiler pressures are very high, or unless superheaters are used. 500 to 600 degrees Fahrenheit are common for induced and forced drafts. Higher temperatures are often met with when the grates are forced to high rates of combustion. In such cases the temperature may be 600 to 800 degrees Fahrenheit, or even higher, but these temperatures are undesirable on account of the heat waste.

Q.—We have a 10-kilowatt direct-current electric generating set used for lighting purposes, and I have noticed that the carbon brushes get very hot when the generator is loaded. Can you tell me if this is all right; and if not, what to do to remedy it? E. G.

A.—The heating of commutator carbon brushes to a temperature much higher than the hand can bear is undesirable, and may be due to (1) conduction of heat from some other hotter part of the dynamo, (2) sparking, (3) arcing across the mica insulation of the commutator segments, or (4) imperfect electrical connections between the bushes and the brush holder. No. 1 is a structural or design defect and the operator can do but little to remedy it. It is, however, uncommon. No. 2 is oftentimes present in a sufficient amount to cause heating and yet be scarcely visible. Well-fitted and properly looked-after brushes and a smooth commutator surface will usually take care of this. No. 3 is usually due to the collection of metallic particles over the face of the commutator and the remedy is to clean the commutator thoroughly. No. 4 frequently occurs with carbon brushes. In general, carbon brushes heat more than metallic ones, especially if they do not fit well against the commutator. The remedy is obvious. Carbon brushes should not be depended upon to carry more than 40 amperes per square inch of contact surface.

Q.—I have noticed that steel boilers having high tensile strength, say, 60,000 to 65,000 pounds per square inch, are more susceptible to galvanic action and corrosion than the old iron boilers of 40,000 to 45,000 pounds per square inch tensile strength of former times. Why is this? L. S.

A.—This is a much-discussed question, and it is probable that the tensile strength has no influence upon corrosion, the real factor being the difference in chemical composition, or the difference in process of manufacture between iron and steel. It is a well-established fact that iron, especially as manufactured some years ago, corrodes less easily than steel, although its corrosion varies in different specimens more than in the steel, and this variation is often greater than the difference in corrosion between iron and steel. Of course, when working with a material of lower tensile strength it is necessary to make the parts of greater thickness, and this increased thickness furnishes a larger margin against the corrosive action and consequent longer life. In general, a good, pure metal suffers more than a hard inferior one, and, as steel may be regarded as a particularly good homogeneous iron, it is suggested by some that this accounts for the difference.

Q.—How do you estimate roughly or approximately the pulling power exerted by a winch or windlass? S. M.

A.—From tests which have been made at the Massachusetts Institute of Technology, upon the efficiency of an anchor windlass of large size, the overall efficiency of the unit or the ratio of useful horsepower to indicated horsepower was about 35 percent, so that it is possible that from 30 to 40 percent of the indicated horsepower available at the cylinders is available for actually lifting weights. The indicated horsepower of the cylinders can be determined by the customary calculations for probable

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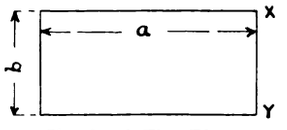
mean effective pressure of engine cylinders. Using this, if the indicated horsepower of the cylinders were 20, we might expect to actually do in one minute $\frac{20}{3} \times 33{,}000$ foot-pounds, a distance of 22 feet in one minute.

Q.—(1) In a flat, rectangular plate firmly secured along all four edges and loaded with a uniform load, what is the tension in the plate in the direction of "a" and of "b" at any section?

(2) In a flat, rectangular plate firmly secured, etc., and loaded with a



Sketch of Flat Plate

uniformly varying load along, say, the "b" axis, i.e., a load of zero at "X" and a maximum at "Y," what would the tension be?

(3) In a flat, rectangular plate supported along all four edges, what would be the tension when loaded as in questions (1) and (2)?

(4) In a circular plate, what would be the tension along the diameter and around the edge when the edge is fixed (1) and loaded with a uniform load (2), a uniformly varying load (3), and when supported and loaded as in (1) and (2)? DRAFTSMAN.

A.—In all the questions asked the solution when possible involves the use "in extenso" of the theory of elasticity, and except for some of the cases in which the rules work out to a simple and readily applicable form, "Draftsman" should make use of any of the standard works upon this subject, such as "Theorie der Elastizitat und Festigkeit," by Grashof," or "Applied Mechanics," by Gaetano Lanza. The following are taken from "Design of Steam Boilers and Pressure Vessels," by Haven and Swett:

f = intensity of stress.

$\frac{1}{m}$ = Poisson's ratio.

u = experimental constant

p = load per unit area.

r = radius of plate.

t = thickness.

Answer to Question 1:

$$f = \frac{u}{2}\left(\frac{a^2}{a^2+b^2}\right)\frac{b^2p}{t^2}.$$

u varies from 9/8 to ¾, according to degree of fixedness of edge. Use $u = \frac{3}{4}$, value for good degree of rigidity.

Answer to Question 2: This is too involved to deal with here. See references.

Answer to Question 3 (a): Use above formula with value of $u = 9/8$, value for entire flexibility.

Answer to Question 4 (a, 1):

$$\text{Center } f = \frac{pr^2}{2t^2} \qquad (\text{using } m = 3)$$

$$\text{Circumference } f = \frac{3pr^2}{4t^2} \qquad \left\{\begin{array}{l}\text{using } m = 3\\ \text{apparent stress}\end{array}\right\}$$

Radial direction at circumference

$$f = \frac{3}{4}\left(\frac{m^2-1}{m^2}\right)\frac{pr^2}{t^2} \qquad (\text{true stress})$$

Answer to Question 4 (b, 1):

$$f = \frac{3}{8}\,\frac{(m-1)(3m+1)}{m^2}\,\frac{pr^2}{t^2} \qquad (\text{true})$$

$$f = \frac{5pr^2}{6t^2} \qquad (\text{true, using } m = 3)$$

$$f = \frac{3}{8}\left(\frac{3m+1}{m}\right)\frac{pr^2}{t^2} \qquad (\text{apparent})$$

Q.—Are centrifugal pumps of the high-speed type, such as those direct-connected to turbines, ever used for circulating pumps for condensers? S. S.

A.—High-speed centrifugal pumps, usually turbine driven, have found favor for circulating pumps for shore condensing plants and have been used to a limited extent for marine work. Here, however, the necessity for frequent variations in speed of the circulating water on account of changing injection temperature and the wide range of these changes imposes a condition of speed control which is inimical to efficiency at some speeds. This is probably why the slow-speed steam engine-driven unit is still preferred for this service in many cases.

Q.—Can you tell me if there is any relationship between the temperature of discharge of the circulating water and the vacuum maintained in the condenser; also, is the temperature from the air-pump discharge much affected by changes in vacua? H. L.

A.—The temperature of the discharge water should be a little lower than the temperature of saturated steam corresponding to the vacuum—enough lower to insure condensation but no more, as heat is then thrown away. Desirable temperatures as recommended by R. M. Neilson (Institution of Engineers and Shipbuilders of Scotland, Vol. LIII) are tabulated below:

Pressure, Pounds.	Vacuum 30 Inches, Barometer Inches.	Saturated Steam Temperature, Degrees F.	Economical Outlet Temperature of Water, Degress F.
0.75	28.48	93	88
1.00	27.98	102	94
1.25	27.46	110	100
1.50	26.96	117	105
1.75	26.46	121	110
2.00	25.96	127	114
2.25	25.42	131	117
2.50	24.92	135	120

If temperature close to these given cannot be maintained for the vacua given, there is probably an excessive air leakage into the condenser.

Q.—Will you kindly give me information concerning the probable cause of sparking on the commutator of an electric generator? S. E. C.

A.—The sparking on the commutator may be due to a number of different causes. The commonest ones are perhaps the following:

1. A rough or uneven commutator surface which causes the brushes to jump slightly. This is best remedied by using a fine file on the commutator while the armature is in motion with the field cut out, or by using fine sand paper applied by a block of wood hollowed out to fit the commutator. Care should be taken to remove the sand and copper dust when the job is finished. Emery cloth should never be used. If the surface is very uneven, it may be necessary to remove the armature and turn up the commutator in a lathe.

2. Poor brush contact due to insufficient brush pressure or to poorly fitting brush ends, so that the brush makes contact at but a few points. If the commutator is very foul the ends of the brushes may become dirty and give this effect.

3. Excessive current on account of overload or due to short circuit on the supply mains.

4. A short circuit coil or a broken coil in the armature. This is usually located at one point on the armature—i. e., the commutator in whose segment the trouble lies.

5. Grounds in the armature winding, such as accidental electrical contact between two or more points of the armature conductors.

Q.—Will you kindly enlighten me on the subject of testing steel forgings? I am not very proficient in mathematics and, therefore, do not understand just how the deductions are arrived at. The sample tested was 10 inches overall in length, turned down to .498 inch, the area of cross-section being .1960 square inch. The test piece was punch-marked 2 inches and 4½ inches apart. The piece broke under a tensile stress of 14,500 pounds and broke right in one of the 2-inch punch marks and showed an elongation of 11.5 percent for the 2-inch marks. The 4½-inch punch marks were placed on the 1-inch diameter sections and elongated to 4.83 inches. Can any data be obtained from the 4½-inch

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marks? The reduction of area was 29.2 percent, or, reduced diameter, .419 inch. The load per square inch reported was 74,300 pounds. The ultimate strength, 63,900 pounds, and the elastic limit, 12,460 pounds. The fracture was one-half cup silky. The material analysis was carbon, 33 percent; phospaorus, .007; sulphur, .026; manganese, .40; silicon, 1.40. I will appreciate it very much if you will show me how this was worked out, and also if the material is first-class and suitable for marine engines. Will you also kindly inform me of some text-book dealing with the elementary principles? M. C.

A.—No reliable information can be obtained from the 4½-inch punch marks, as the sectional area between them is not constant. As to suitability: Lloyd's requires for steel forgings for marine engines a breaking strength of 28 to 32 tons (long) accompanied by an elongation of not less than 29 and 25 percent, respectively, so that an elongation of but 11.5 percent is entirely insufficient. Moreover, the elastic limit is given as 12,460 pounds. This probably refers to total load and not stress per square inch, in which case the elastic limit is at about 85 percent of the tensile strength, which is abnormally high for material for marine engines. The material comes more nearly in the class of cold-rolled steel axles, as given in the Standard Specifications of the American Society for Testing Materials, 1914, and is entirely unsuitable for the use mentioned. In testing a bar of this sort, the ratio of the lengths between the 2-inch punch marks before and after breaking gives the elongation. The elastic limit is derived by measuring the elongation as each tensile load is applied and plotting a curve of loads on elongations. When the elongations increase faster than the loads, the elastic limit is considered to have been reached. This curve, called a "stress-strain diagram," has its highest point and, therefore, greatest load (in the case of steel) before the breaking point, which accounts for the maximum load of 74,300 pounds per square inch being in excess of the breaking load.

For an elementary treatment of the general question of strength of materials see "Strength of Materials" (a Text-Book for Manual Training Schools), by M. Merriman, or "Text-Book of Mechanics," Volume III, by L. A. Martin, Jr., both published by Wiley & Son, New York. For an excellent elementary book on the testing of specimens and their behavior see "Laboratory Manual of Testing Materials," by Hatt and Scofield, published by McGraw-Hill Book Company, New York.

The Old Navy and the New*

BY WALTER M. MC FARLAND

The momentous change in the personnel of the navy, which resulted from the enactment of the Personnel Law in 1899, marked the development of the old navy into the new. As one who is very proud of having been a member of the old navy for nearly a quarter of a century, I will say at once that, under conditions as they existed, and with the knowledge at the time, the old navy was very efficient. There had been a time in my own early days when conditions were almost disheartening, because we had not been allowed to build a new ship or a new gun for many years. More than a decade, however, before the Personnel Bill, the Congressional policy of intense economy and retrenchment had been modified, so that we began building modern vessels with the guns and other equipment thoroughly up to date. Indeed, in some features, we led the world. All this had a very beneficial effect on the personnel, as supplying an opportunity for the application of the best thought and ability.

* Extracts from an address delivered at the annual banquet of the American Society of Naval Engineers, Washington, D. C., Feb. 20.

It was recognized by everybody, both in the service and out, that the most important feature of the change brought about by the Personnel Law was the absorption of the Engineer Corps, and all its duties, by the Line. It was realized that, for a time, engineering duty would be performed, as before, by those who had specialized in it, but that immediate steps must be taken to make engineering just as much a part of the line officer's training as seamanship, navigation or gunnery. For a time the senior engineers of the large vessels, and fleet engineers of squadrons, continued to be officers who had always been identified with engineering; but after some six or seven years nearly all of these officers came into the class specially charged with shore duty, and all the engineering afloat was performed by officers of the new school. The enthusiasm and professional skill displayed by these young officers are deserving of high praise.

In the new navy efficiency in engineering is not left entirely to the sense of duty of those who have charge of the machinery, but a great many of the younger officers, who have made application for the course, have been given special instruction in designing and advanced theory at Annapolis and at Columbia University. In addition to this, the bureau encourages suggestions from officers, and issues from time to time bulletins giving to the service the benefit of valuable experiments wherever gained. This is of the very greatest value in maintaining high efficiency and enthusiasm. In the friendly competition for the efficiency trophy, engineering counts very high, and I have been told that every officer on the ship is just as keen to see the engineering efficiency high as to attain a high mark in gunnery.

During the administration of that grand old man of engineering, Admiral Melville, we were in the forefront of progress in everything relative to marine machinery. This record has been maintained, and there is every reason to believe that it always will be maintained. We need only mention Diesel engines in the *Maumee*, the mechanical reduction gear on the *Neptune* and the electric reduction gear on the *Jupiter* to realize that nothing which promises improvement is neglected. As for wireless telegraphy, I cannot speak with authority, but I believe that it is generally conceded that our naval installations are leading the world.

Discussion of the new navy thus far has related very largely to the fleet, because, after all, that is the navy; but vessels need overhauling and repairs, and it is sometimes desired to build new ones in our navy yards, so that we naturally come to the consideration of the shore side of duty. Until recently, the chief engineers of the navy yards were officers who had always been identified with engineering. Gradually, however, their places have been filled by line officers trained for general service, and for a long time the subordinates have been officers with such training. Here, too, the record is entirely satisfactory, and shows that the officers of the "new model" are thoroughly competent for all duty which is assigned to them.

There are questions of administration and various other matters of personnel which are still open to improvement. I have been greatly interested in suggestions looking to the incorporation in the line of two of the other corps, and I believe that this would result in great benefit to the service. With all of the officers who have to do with the building and operation of ships members of one homogeneous body, there would be no longer room for any bickering or strife, except that due to personal peculiarities.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries — Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Economy of Coal and Boiler Corrosion*

BY LIEUT. G. J. MEYERS, U. S. N.†

Economy of coal and boiler corrosion are two topics of the day that many marine engineers are desirous of having light shed upon in a practical way. The brief remarks presented are from experience on a battleship for over two years, and show how economy and boiler corrosion are related.

The writer, as chief engineer of a battleship notorious for its excessive coal consumption, had to face the problem of reduction of coal consumption and prevention of boiler corrosion, and at the same time the maintenance of the machinery in such condition as to be ready for any duty called upon. The attaining of the first two objects was thus a tedious task, requiring a great deal of patience.

The boiler plant consists of twelve Babcock & Wilcox boilers furnishing steam for engines developing 20,000 horsepower at full power. The boilers are now eight years old, having been retubed once.

A systematic record of the work undertaken was as follows, each item being pursued to the bitter end:

1. Tightness of baffles and boiler casings.
2. Cleanliness of boilers on water sides and fire sides.
3. Tightness of condensers.

Every baffle was examined for tightness, the method adopted being the simple expedient of holding a light on one side, and carefully examining baffles for chinks and cracks. The horizontal baffles were found to be the worst leakers of CO direct to the uptakes. These were originally built of brick laid together, but not cemented. All broken or chipped bricks were renewed and the baffles covered on top with a layer of vitrifying cement. The cement is examined frequently and repairs effected immediately, if any is found broken off or chinks are found.

Vertical baffles were all realined, distance pieces secured and brought together so as to reveal no cracks or chinks. This is a tedious process, as it requires a great deal of time and careful inspection to see that no chinks are left in the baffle.

The boiler casings are old and the castings for side doors and tube blowing doors were found broken at the corners and along the edges and could not be renewed except at considerable expense. To eliminate leaks, the casings were gone over frequently with a candle, and all air leaks are now plastered over with a plaster of half fire clay and half loose asbestos. This is inspected frequently while steaming, the bucket containing the mixture of clay and asbestos being kept on hand in the fire-rooms at all times.

After several months of experimental work in cleaning the fire sides of tubes, it was found that for boilers steaming the following method was most effective, as no tube-blowing apparatus was installed in the boilers:

(*a*) *Underway.*—A tube-blowing gang of six men was detailed to start work on the steaming boilers at 8 A. M., and to give each boiler a thorough tube blowing with air each day, working until 4.30 P. M. After letting fires die out in boilers, each boiler is given a thorough tube blowing, everything from the smoke pipe down is swept free of soot, and when this is all removed the fireroom is closed, the ash pan and furnace doors opened, one blower started and all loose soot blown up the stack.

(*b*) *At Anchor.*—The tubes are blown in each boiler under steam once a day, and in case of fires dying out the same procedure is followed as already given.

The cleanliness of the water sides of the boilers is possibly the most important part of the proceedings, as it directly involves corrosion. From the experiments of Lyon on boiler corrosion, it is found that corrosion will cease when the boiler water is kept 3 percent alkaline. To effect this result, Navy standard boiler compound is furnished ships of the navy as required. This compound consists of 76 percent of anhydrous sodium carbonate, 10 percent of trisodium phosphate, 1 percent of starch, and 2 percent of tannic acid derived from cutch only. It acts as a cleanser as well as an anti-corrosion agent.

The first step in the cleaning anti-corrosion campaign was to remove from each boiler all handhole plates, back and front, and run through each tube a turbine cleaner, then to wash out thoroughly the boiler with fresh hydrant water, and finally to swab out each tube with rags or burlap dipped into a strong solution of boiler compound. All headers, water legs, and side boxes were scraped and cleaned as thoroughly as possible with scrapers and old table knives.

When the boiler was closed up and filled, six pounds of boiler compound were put in with each ton of water. The compound was mixed in a coal bucket, cleaned and used only for this purpose. About fifty pounds of compound was mixed in a 100-pound coal bucket, boiled thoroughly with a small steam connection from the auxiliary line, shoved under a ¾-inch suction tapped into the auxiliary feed pump suction and sent into the boiler through the auxiliary feed line. After a boiler was filled and the compound injected, the auxiliary feed pump was used to take water from the boiler by the bottom blow line and send it back to the boiler through the auxiliary feed line, thus circulating the compound in the boiler and making the water as uniformly alkaline in all parts of the boiler as possible.

Tests daily of water of all steaming boilers and weekly of water of all boilers are required. Boiler compound is added as required to each boiler, about 15 pounds being necessary for each 1 percent alkalinity.

After each boiler had steamed at low-pressure for about ten days, with daily blow down of 3 inches in the water glass, the fires were died out and the boiler emptied and given another washing out with fresh hydrant water. When filled, compound was put in the boiler as already described. At no time is alkalinity allowed to get below 3 percent. The boiler compound has kept all scale from forming and reduced corrosion to a minimum.

On some boilers, after a considerable period of steaming, it was found that stalactites of boiler compound were forming on the outside of the front handhole plates. After a little investigation, this was found to be due principally

* Awarded first prize in Engineers' Contest for the best letter on engine room experiences.

† Chief Engineer of the United States battleship *Rhode Island*.

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to salty water in the boiler, this result being reached when the water contained 300 grains or over of chlorine to the gallon. It was then found that the next problem to tackle was condensers and boiler feed. Dirty or rusty bearing surfaces for gaskets of handhole plates and dirt in the boiler also caused boiler compound to come through the joints.

All water from air pump discharges is tested daily and from the reserve bottoms weekly for chlorine and, if chlorine gets up to 5 to 8 grains per gallon, the leak is first localized to one condenser. At the first opportunity this condenser has its handhole plates removed, is filled with water, and examined for weeping. Ferrules found weeping are set up. Almost invariably where water from a condenser is found to be only slightly salty, two or three ferrules are found loose, or have dropped out, due to vibration and rolling of the tubes. To tighten a condenser usually has been found to take a day, and sometimes less, and the trouble involved is a small price to pay for absolutely fresh water.

The reserve feed tanks containing fresh water for make-up feed are filled from shore or from water distilled. Every tank of water from the distillers is tested and should not be run into reserve bottoms, if containing over 5 grains of chlorine to the gallon. The same may be said of water received from ashore—it should be tested for chlorine before being taken aboard. Usually make-up feed from the distillers does not exceed two grains of chlorine per gallon of water.

The above three points properly taken care of with the usual work required to keep joints on piping, piston rings, steam slide valves, and piston rod packing tight, have resulted in an actual gain in economy for the five months from July 1 to December 1, 1914, over the previous year of 71 percent.

The following is a description of the water-testing apparatus used and of the method of making tests:

Apparatus

1. Two burettes graduated to 1/10 cc. at 15 degrees C., 50 cc. capacity, for alkalinity and chlorine tests.
2. One white porcelain dish of 200 cc. capacity.
3. One measuring cylinder graduated to 1 cc. at 15 degrees C., 100 cc. capacity.
4. One glass stirring rod and four eye droppers.
5. One glass beaker 150 cc. capacity for pouring solution into burettes, etc.

Chemicals

6. One thousand cc. of one-half normal nitric acid (HNO_3).
7. One hundred cc. methyl orange solution (1/10 gram of methyl orange in 100 cc. of distilled water).
8. Five hundred cc. of normal anhydrous sodium carbonate (anhydrous Na_2CO_3).
9. One thousand cc. nitrate of silver solution (4.101 grams $AgNO_3$ c. p. in 1 liter of distilled water).
10. One hundred cc. potassium chromate solution (1 gram K_2CrO_4 in 100 cc. of distilled water).

Alkalinity Tests

1. Draw a sample of water to be tested into a collecting vessel which has first been washed out with water from which sample is drawn.
2. Fill burette with nitric acid solution. Record reading of scale at surface of solution.
3. Measure 50 cc. of sample of water in cylinder and place in porcelain dish under burette.
4. Drop 2 drops of methyl orange with an eye dropper into sample of water in porcelain dish.
5. From pet cock at bottom of burette, draw nitric acid into sample, stirring continuously with glass rod until sample turns to a faint pink. Close pet cock and read scale at top of solution in burette. The difference between this reading and reading taken in (2) indicates number of cc. of acid required to neutralize the alkali in the sample. Each cc. of difference is equal to 1 percent of alkalinity; that is, if difference is 3.4 cc., the water is 3.4 percent of normal alkaline strength.

Chlorine Tests

6. Make sample in dish neutral by adding sodium carbonate solution until sample just turns yellow. One drop should be sufficient.
7. Replace burette containing nitric acid with burette containing nitrate of silver.
8. Add to the sample four drops of potassium chromate solution with an eye dropper.
9. Read scale at surface of silver nitrate in burette.
10. From pet cock at bottom of burette, draw silver nitrate into sample, stirring continuously with glass rod until sample turns a reddish yellow color throughout. Close pet cock and read scale at top of solution in burette. The difference between this reading and reading in (9) indicates the number of cc. of nitrate of silver required to precipitate all of the chlorine in the sample.
11. With this strength of nitrate of silver solution each cc. used in the 50 cc. sample indicates 1 grain of chlorine to each gallon of the water tested; that is, if the difference in readings is 36 cc., the water contains 36 grains of chlorine to the gallon. If chlorine is known to be more than 50 cc. to the gallon use the following tests:
12. Pour into measuring cylinder 5 cc. of the sample after performing (6).
13. Add to the 5 cc. two drops of potassium chromate with an eye dropper.
14. Then add silver nitrate solution until contents of cylinder turn a reddish yellow color throughout.
15. Read cylinder scale at top of contents. From this subtract 5 and multiply remainder by 10. The result is the number of grains of chlorine per gallon in water tested. Thus, if reading is 45, $(45—5) \times 10 = 400$, and water tested contains 400 grains of chlorine to the gallon.

Interesting Change in Twin Screw Steamer*

BY D. SAWYER †

One of the most interesting jobs I ever took part in was on a twin screw light draft steamer of about 1,200 tons displacement. When built she was fitted out with pipe boilers and four-cylinder triple expansion engines, allowed a steam pressure of 250 pounds and developed on forced draft 3,300 indicated horsepower. She made about 21 miles an hour. Her wheels turned in.

Owing to bad feed water, condenser troubles, etc., the pipe boilers were not at all satisfactory, and when her sister ship was built about eight years later it was decided to install Scotch boilers in the new boat, hence materially reducing the power and speed. Also the engines of the new boat were three-cylinder triple and her wheels turned out.

Soon after the new boat was placed in commission the

* Awarded second prize in the Engineers' Contest for the best letter on engine room experiences.

† Chief Engineer, S. S. *Northland*, the Norfolk and Washington Steamboat Company, Norfolk, Va.

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older one was taken off and reboilered, the new boilers being duplicates of those in the new boat.

It should be borne in mind that the two boats were built on the same lines, and after the older one was reboilered they were of approximately the same displacement. Evidently now there was no material difference in the power, as the boilers were identical and the triple expansion engines used the steam generated at about the same ratio of economy; on the older boat, however, the wheels turned in, while on the new one they turned out.

As a matter of fact, in deep water they did make practically the same time, about 18 miles an hour, but in shoal water in which about 25 percent of the run was made, the

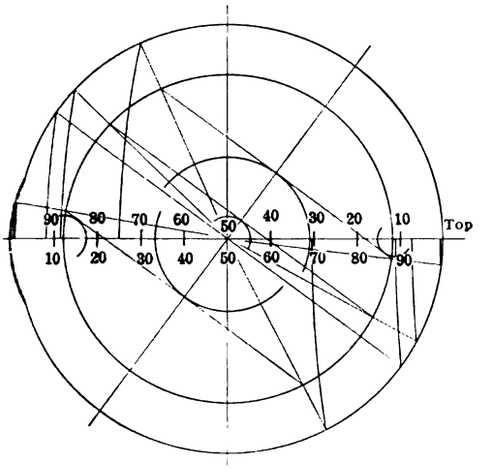

Fig. 1.—Valve Diagram No. 1

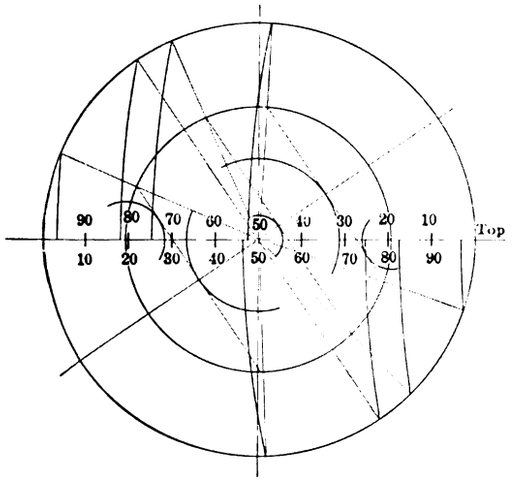

Fig. 2.—Valve Diagram No. 2

new boat made by far the best time. We decided that this was due to the difference in direction of rotation of the wheels and that this could be altered at no great expense. Both boats were run over the same course daily, the new boat at night and the older one on the day run. The run was of about three hours' duration with about six hours lay up and then return. We had her original valve data (I am speaking now of the older boat) and this for the high-pressure engines will be seen by reference to valve diagram No. 1 (see Fig. 1) and corresponding data.

On a trip over one morning we took indicator cards Nos. 1 and 2 on one of the high-pressure engines. (Of course we took cards on all the cylinders, but that is of no interest here.) Card No. 1 was taken with the link "all the way out," and corresponds to valve diagram and data No. 1. Card No. 2 was taken with the link "in three notches," where it had been customary to run it since the reduction in boiler power. This card corresponds to valve diagrams and data No. 2.

As soon as we reached port we disconnected the top ends of all the eccentric rods and reassembled with the rods crossed. While doing this we had three inches cut out of the high-pressure bridle bars, this being necessary now to link her up, as the links would have to stand in the "reverse" position to work ahead, and the slots in the

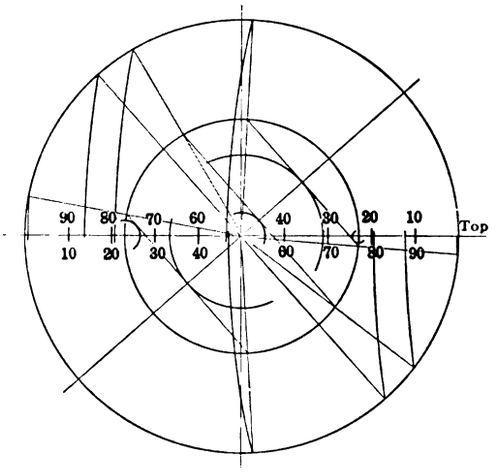

Fig. 3.—Valve Diagram No. 3

rocker arms for linking up were brought nearly vertical and hence useless as a linking up device, but of course the block had to be run in three notches to compensate for what was cut out of the bridle bars when the links were thrown in their original ahead position, which was now the backing "motion." We then started out on the return trip, and on the way over took another set of cards. No. 3 is the high-pressure card of this set and corresponds to diagram and data No. 3. It is clear at a glance that No. 3 card represents a better condition than No. 2.

After this experimental trip we allowed her to run this way for several weeks, when she went to the yard for her semi-annual docking, when we took off the wheels and replaced them on opposite shafts—that is, the starboard wheel on the port shaft and vice versa. We also brought the high-pressure bridle bars back to their original length, and now with the links standing in their original ahead position the wheels turned out and ahead.

Her time was immediately improved in shoal water fully up to our expectations. Taking the whole run, she gained nearly five minutes an hour and the gain was practically all in shoal water. Also there was very great improvement in her handling, considerable time being saved on this account in shifting around the harbor, as she could now be maneuvered with very much greater facility than before. There was no difficulty with the guides, as she was fitted with bar guides, thus having as much wearing surface on one side as the other.

It must be remembered, though, that her engines were built for high speed, and she made something like 21 miles an hour on her trial trip, whereas now she is run at about 18 miles an hour, owing to the reduction in boiler power and increase in displacement, due to the difference between the original pipe boilers and the present Scotch

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Valve travel	Position No. 1. Open Rods Full Stroke of Valve 5"		Position No. 2. Open Rods Linked Up 3 Inches 4"		Position No. 3. Crossed Rods Linked Up 3 Inches 3½"	
	Top	Bottom	Top	Bottom	Top	Bottom
Steam Lap (inches)	1 7-32	1 3-32	1 7-32	1 3-32	1 7-32	1 3-32
Exhaust Lap	11-32 Negative	0	11-32 Negative	0	11-32 Negative	0
Angular Advance	¼	⅜	13-33	17-32	1-16	3-16
Steam Lead (inches)	3/32		Equivalent to 5½		Equivalent to 4½	
Cut-Off (inches)	19½	17¼	14½	12 1-16	14	12
Cut-Off (percent)	.752	.69	.548	.462	.54	.46
Release (inches)	23.04	22.98	20	19 7-16	20 11-16	20 13-16
Release (percent)	.886	.884	.77	.752	.795	.80
Compression (inches)	1.9	2.03	4½	4¾	3 7-32	3½
Compression (percent)	.073	.078	.17	.168	.123	.13
Steam Opening (inches)	1 9-32	1 13-32	25-32	27-32	17-32	19-32
Exhaust Opening (inches)	Full Ports		Full Port	2	2 1-16	1⅞

Piston Stroke, 26 ins.; Connecting Rod, 61½ ins.; Eccentric Rods, 61½ ins.; Working Length of Link, 14 ins.
Scale of Crank Circle 1½ ins. = 1 ft. Scale of Valve Circle, half size; Port Width, 2¼ ins.

boilers. The engines were fitted with exceptionally large valves and ports, the high-pressure and intermediate valves being 11 inches in diameter and the low-pressure having two each of 12 inches diameter. The cylinder

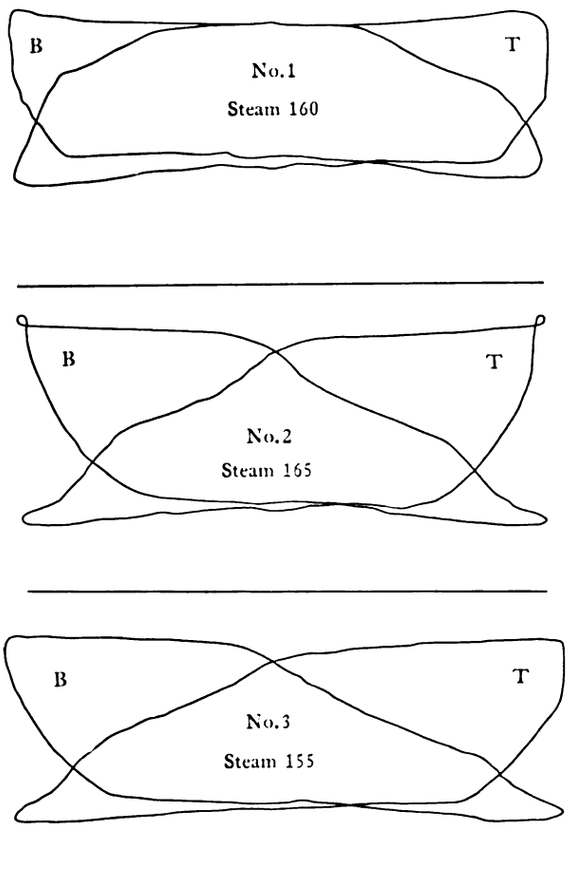

Fig. 4

diameters were 18 inches, 29 inches and 32 inches by 26-inch stroke.

It is no doubt due to the large valve and ports, together with the reduced speed, that the great reduction in valve travel and port opening did not cause wire drawing in the high-pressure cylinder. Of course, the valve movements of the intermediate and low-pressure cylinders were not affected by crossing the rods, as they were not linked up. Under the same conditions the engines developed about the same total indicated horsepower with the rods crossed as before.

Valve diagrams Nos. 2 and 3 were made by the method quoted by Seaton, for which credit is given to Mr. McFarlane Gray. The data formed by the diagrams seem to check up pretty closely with what actually occurred in the engine.

Preventing the Freezing of a Keel Condenser*

BY JOSEPH CHURCH, 2D

The writer is at present employed on a steamer which operates the whole year through, and which is fitted with a keel condenser. Several times during the winter months, or until I found a way to overcome it, the condenser used to freeze and, in order to thaw it out, I had to put about a peck of salt into each end of the condenser and wait from twenty-four to forty-eight hours for it to eat its way through. Strong pickle would have kept it from freezing, but that would have made it necessary to have a large amount of salt on hand, so I set to work to find another way.

I finally decided to try plain sea water, as it never freezes except on the surface. Accordingly, each night before leaving the vessel I inserted the hose in the end of the high-pressure exhaust pipe, and after opening a valve on the other end of the condenser, I pumped in sea water until all the fresh water had been forced out. I have been doing this for two winters and find that it keeps the condenser from freezing. Care must be taken, however, to discharge all the sea water overboard when starting up again.

Warship Construction in Navy Yards

Having read with much interest in your issue under date of December, 1914, the comments entitled "Bids for New Destroyers," I am constrained to say a few words in favor of naval construction in Government navy yards, particularly at Mare Island, California. Having had about six years' experience as a hull draftsman at that station, as well as a number of years in the shipyard and drafting room of a private shipbuilding concern, it would seem that in some measure I may be competent to speak on the subject.

You state that past experience has given ample proof that it is practically impossible for a navy yard to build a warship as cheaply as a private shipyard can build it. This is no sufficient reason why warships should not be constructed at Government navy yards—in fact, it is just the reverse. Admitting that Government-built ships have cost more does not prove that it will be so with the present and future contracts. The estimates and bids from Gov-

* Awarded third prize in the Engineers' Contest for the best letters on engine room experiences.

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ernment navy yards are becoming lower, due to more efficient management and up-to-date methods, which also has the effect of keeping the estimates and bids of private contractors down to somewhere near what they ought to be in order to give them a reasonable profit, to which they are justly entitled.

You further state that the cost of repairs on Government-built vessels invariably amounts to a larger sum than the cost of repairs to a contract-built ship. I am not aware that there are any available data that will prove this statement to be true. However, if such be the case, it does not prove that Government work is inferior to that of private shipbuilding plants. The causes which necessitate repairs are varied, and include accident, carelessness, etc., and not necessarily inferior material or workmanship in the original contract. Moreover, a Government-built ship is constructed from the same specifications as those furnished to private contractors, and the specifications must be followed to the letter.

The failure of private shipbuilding firms referred to may have been due to other causes, such as mismanagement, labor troubles, inexperience, etc.

But the statement to which I take particular exception is the one relative to Government employees, in which you say that it is physically impossible for a Government yard, which must depend upon employees inexperienced in construction work, to turn out a naval vessel of the type of the new destroyers at about $200,000 (£41,000) less than it is possible for a private shipyard, with its years of experience and its skilled organization trained in this particular kind of work, to do the same work.

This statement, more especially the part relative to employees and skilled organization, is absolutely untrue and misleading, being without foundation of facts, and is, therefore, an injustice, to say the least. The work done at Mare Island Navy Yard during the last five years, which includes the collier *Jupiter*, the river gunboats *Monocacy* and *Palos*, and the fuel ships *Kanawha* and *Mammee*, will compare favorably both in cost and quality with any of the private shipbuilding concerns of the country. In fact, as shown by the annual report of the Chief of the Bureau of Construction and Repair for the fiscal year 1914, the total cost of the gunboats *Monocacy* and *Palos*, which were built at the Mare Island Navy Yard, transported to Shanghai, China, and there re-erected by contract, was only two-thirds of the bid received from one private shipbuilder f. o. b. shipyard.

These vessels are of light construction, and in some respects the work is similar to that required in the construction of destroyers. The experience gained and results accomplished would seem to indicate that the estimates submitted are worthy of careful consideration by the Navy Department, and it was no surprise to learn that the contract for one destroyer had been awarded to the Mare Island Navy Yard. The present construction officer, Mr. H. M. Gleason, Naval Constructor, U. S. N., who has been in charge of hull construction for several years, and under whose supervision the last four named vessels have been built, is a man of exceptional ability in his profession, and all the way down the line through the drafting room, shops and shipyard can be found men who have had years of experience in the private shipyard with their skilled organization to which you have referred.

Moreover, I may state in this connection that there are no loafers, and none need apply, for if they should be taken on they would have to go to work and keep at it. If there are unskilled and inexperienced employees, or lack of skilled organization in Government navy yards, that fact alone is one of the strongest arguments in favor of building ships in Government navy yards. How can any shipbuilding plant employ and maintain a skilled and efficient force of men without the necessary work to keep them continuously employed?

It is the opinion of the writer, as well as that of many other men more competent to judge, that the Government ought to have under construction all the time naval vessels, so as to keep a large efficient force of men at work in at least two Government navy yards—one on the Atlantic and one on the Pacific coast—so that in case of an emergency the Government would not be at the mercy of private contractors, who charge all they can get in order to pay dividends, or what they consider a fair profit.

U. S. Naval Station, Olongapo, P. I. P. F. PETERSON.

A Peculiar Accident

On January 30, 1914, about 6 P. M., the tug *W. G. Wilmot*, while proceeding up the Mississippi River from New Orleans, La., met with a peculiar accident. Although under full steam, the engine suddenly stopped, and before the steam could be shut off the engines again started with a sudden jar.

When the steam was finally shut off it was found, upon investigation, that the propeller had struck a very large water-soaked cottonwood log, and one of the blades of the 13-foot propeller had embedded itself in the log for a distance of 2 feet after having broken off at the hub.

A line was made fast to the broken blade, and, by means of the capstan, it was pulled on board the vessel.

New Orleans, La. W. R. P.

A Criticism

In the November, 1914, issue of INTERNATIONAL MARINE ENGINEERING, the article on the sternwheel river towboat *Advance* contains two very misleading and incorrect statements which require correction.

First.—It is stated that other boats comparable with the capacity of the *Advance*, 150 feet long by 28 to 32 feet beam, draw 4 feet of water. When such a boat is drawing 4 feet she will have approximately 250 tons of fuel on board or, in round numbers, a supply for 250 hours of running time. On the other hand, the *Advance* has 40 tons of oil fuel, a supply for approximately 80 hours of running time.

Second.—Again, the writer of the article says: "In a boat with 'Western River Boilers,' safety is neglected altogether, service is considered only in a limited way, etc." This is the veriest rot. The Roberts type boiler on the *Advance* has its upper shell built under the U. S. marine requirements on a supposed factor of safety of 6. Every Western river boiler is built under like specifications. The *Advance* boiler has not been in commission sufficiently long to entitle it to a reputation for reliable service. Other similar boilers have signally failed and have been replaced by Western river boilers, greatly to the benefit of the service.

The *Advance* has very good propelling machinery, but no better than other boats using the same design, of which there are a number.

Chicago, Ill. JNO. M. SWEENEY.

ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEER.—The next annual meeting of the Society of Naval Architects and Marine Engineers will be held on Thursday and Friday, Nov. 18 and 19, 1915, at the Engineering Societies' building, 29 West Thirty-ninth street, New York City. The annual banquet of the society will be held on Friday evening, Nov. 19, at the Waldorf-Astoria Hotel.

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Recent Launches

The lumber steamer *William O'Brien*, described in our last issue, built by the New York Shipbuilding Company, Camden, N. J., from designs by Edward S. Hough, naval architect and marine engineer, of San Francisco, Cal., for the Carpenter-O'Brien Company, New York, was successfully launched Feb. 27. The vessel is 361 feet 9 inches long between perpendiculars; 51 feet beam molded, 27 feet depth molded with a load draft of 21 feet 6 inches. Her gross tonnage is 5,535 and she is propelled by a triple-expansion engine of about 2,200 indicated horsepower designed to give a speed at sea of 11 knots.

On March 4 the New York Shipbuilding Company also launched the United States destroyer tender *Melville*,

Launch of the *Melville*

which is of 7,150 tons displacement, 400 feet long, 54 feet 3 inches beam and 36 feet 3 inches depth with a draft of 20 feet. The propelling machinery, designed to give the vessel a speed of 15 knots, consists of two Parsons turbines turning a single screw through reduction gearing, steam being supplied by two Babcock & Wilcox water-tube boilers. The vessel is especially equipped to perform the duties of a supply depot, repair shop and escort to torpedo boat destroyer flotillas, and is armed with eight 5-inch rapid-fire guns.

At the yards of Messrs. Verdon & Co., West New Brighton, N. Y., the steam lighter *Robert L. Stevens*, designed by Cox & Stevens, naval architects, New York, for the Rock Plaster Manufacturing Company, New York, was launched on March 10. The lighter is 97 feet long overall, 28 feet 6 inches beam and 10 feet depth of hold with a draft of 9 feet 6 inches. The hull is of wood and so designed that a normal cargo of 175 tons can be carried on deck. Propulsion is by a single-cylinder reciprocating engine.

The battleship *Pennsylvania*, of 31,400 tons displacement, was launched at the yards of the Newport News

Launch of the *William O'Brien*

Shipbuilding & Dry Dock Company, March 16. The sponsor was Miss Elizabeth Kolb, of Germantown, Pa. The *Pennsylvania* has a length of 608 feet between perpendiculars; a beam of 97 feet; a normal draft of 28 feet 10 inches, and a speed of 21 knots. Propulsion is by a four-shaft arrangement of improved Curtis turbines designed to develop a total of 32,000 shaft horsepower at 220 revolutions per minute. In addition to the main high- and low-pressure turbines, the engine installation includes high- and low-pressure cruising turbines connected to the outboard shafts by clutches and actuating the shafts through reduction gearing. Steam is supplied by 12 oil-fired watertube boilers. The main battery consists of twelve 14-inch guns mounted in four triple turrets on the centerline of the ship.

LLOYD'S SHIPBUILDING REPORT.—Statistical tables issued by Lloyd's Register of Shipping for the year 1914 showed that the total addition of steam tonnage to the Register of the United Kingdom during 1914 has been 1,542,353 gross tons. For sailing tonnage, the figures were 16,919 gross tons, making in all 1,559,272 gross tons. The gross deduction of steam tonnage from the register amounts to 1,080,246 tons, and of sailing tonnage, 74,396 tons, making in all a deduction of 1,154,642 tons. On the whole, during 1914 the number of steamers on the official register of the United Kingdom has increased by 252 and the tonnage by 462,107 tons, while the number of sailing vessels has decreased by 133 and the tonnage by 57,477 tons. The total number of vessels on the register has, therefore, increased by 119 and the total tonnage by 404,630 tons during the year.

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Marine Articles in the Engineering Press

Reports of Scientific Investigations Covering Marine Engineering Problems—Brief Descriptions of New Vessels and Machinery

Oil Fuel as Applied to Marine Boilers.—By A. J. Walker. A prize essay giving a thoroughly illustrated description of the various arrangements for burning oil under marine boilers. 7 illustrations. 2,130 words.—*Transactions of the Institute of Marine Engineers,* November, 1914.

The Future of British Engineering and Shipbuilding.—By E. W. Frazer Smith. A brief review with data showing the development of engineering in Great Britain, emphasizing the tendency toward progress or retrogression in the various branches at the present time. 3 illustrations. 6,800 words.—Paper read before the *North-East Coast Institution of Engineers and Shipbuilders,* February 26.

Experiments on the Influence of Indicator Connecting Pipes.—By Thomas B. Morley, B. Sc. The investigation was carried out to endeavor to find out whether the arrangements commonly used for attaching indicators to the engine cylinders are responsible for measurable errors or not. The conclusion is that on the whole, unless in abnormal cases, indicator diagrams are not subject to any appreciable error due to the influence of connecting pipes. 4 illustrations. 2,570 words.—*Transactions of the Institution of Engineers and Shipbuilders in Scotland,* February.

The Progress of Reform in the Engineer Branch of H. M. Navy.—By D. B. Morison. The author traces out the revolutionary changes in *materiel* in the British Navy which were followed by corresponding reorganization and reforms of the *personnel.* The practical significance of the value of engineering and engineers in naval warfare is emphasized. The reform movement in this direction culminated in the action of the Admiralty on the first of this year in classifying all engineer officers in H. M. Navy as a part of the military branch. The harmony of view and intention now prevailing augurs well for the future of the navy. 6,800 words.—Paper read before the *North-East Coast Institution of Engineers and Shipbuilders,* February 26.

The Improvement of the River Clyde and Harbor of Glasgow, 1873 to 1914.—By Sir Thomas Mason. During the last forty-one years the growth in the size of trading vessels on the Clyde has been very great, the tonnage having increased by 325 percent, the length by 56 percent, breadth by 69 percent and draft by 48 percent. Quayage has increased three times, tonnage of goods handled 4½ times and revenue nearly 3½ times. The water area of harbor and docks, which in 1873 was 76 acres, is now 535 acres. During the period under review the capital expenditure on new works and improvements has been $33,700,000 (£6,913,923). The review describes in detail the various improvements embraced by the entire harbor works, including dock construction, dredging equipment, lighting, terminal facilities, etc., during the period of its remarkable growth.—Paper read before the *Institution of Civil Engineers,* March 9.

Some Notes on Heat Transmission and Efficiency of Boilers.—By R. Royds, M. Sc. After carrying out extensive laboratory experiments to investigate the subject of heat transmission, the author turned his attention to similar investigations on full-sized boilers, so that the results could be compared with those obtained with laboratory apparatus. It was found that the results obtained from various boilers agreed fairly well with the laboratory experiments, and that, while the rate of heat transmission between the gases and water did not appear to be influenced greatly by the temperature of the gases, it would seem that the diameter of the tubes, or the hydraulic mean depth of the gas passage, had an appreciable influence. It is suggested from the results of the boiler tests that one of the most important problems affecting the efficiency of a boiler at high rates of working are the efficient combustion of the fuel. 27 illustrations. 12,500 words.—*Transactions of the Institution of Engineers and Shipbuilders in Scotland,* February.

U. S. S. New York.—By Harrison B. Gregory. A detailed description of the twin-screw battleship *New York,* fitted with reciprocating engines and designed for a speed of 21 knots at 27,000 tons displacement with the engines developing 28,100 indicated horsepower. The vessel was built at the Brooklyn Navy Yard, and is 565 feet long on the waterline with a molded beam of 94 feet 10⅛ inches, a molded depth of 48 feet 8⅛ inches. The draft to the load waterline, corresponding to a displacement of 27,000 tons, is 28 feet 5⅜ inches. The two main engines are of the four-cylinder triple-expansion type with cylinders 39, 63 and 83 inches diameter with a stroke of 48 inches, driving propellers 18 feet 8¼ inches diameter, 19 feet 11 9/16 inches pitch, turning outboard. Steam is supplied at a pressure of 295 pounds per square inch by fourteen Babcock & Wilcox watertube boilers with a total heating surface of 62,213 square feet, a superheating surface of 3,267 square feet and a grate area of 1,554 square feet. Complete details of the hull and main and auxiliary machinery are given, together with the principal results obtained on trial. 5 illustrations. 19,200 words.—*Journal of the American Society of Naval Engineers,* February.

The Governing of Marine Engines and High Speed Auxiliaries.—By R. J. Walker. The fact that it is practically impossible to effectively control by hand the engine speed in a ship in heavy weather, even if "linking-up" is resorted to, has turned the attention of engineers to the question of providing some means of doing this automatically. The impossibility of ever obtaining in marine work the fineness in governing common on stationary engines is obvious. For a marine engine, the ideal governor would be one which would anticipate the subsidence of the water from the ship's stern and cut off the steam or alter the cut-off of the valves before any racing could take place, and also work with enough flexibility to insure that the amount of steam cut off would be in exact proportion to the decrease of load on the propeller, thus keeping the engine speed constant. To show how far the actual results of invention up to the present time have approached this ideal, the author describes in detail practically all known types of marine engine governors, dividing them into two classes—those which act on a variable expansion gear, and vary the speed of the engines by

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altering the cut-off of the valves, and those which throttle the steam at the point of admission to the high-pressure valve casing, thus directly varying the amount of steam which actually enters the engine. 5 illustrations. 3,900 words.—*Transactions of the Institute of Marine Engineers,* November, 1914.

Michell Thrust Blocks for the S. S. Ciudad de Buenos Aires.—A comprehensive description, fully illustrated with detailed drawings, of the Michell thrust block constructed by Messrs. Cammell, Laird & Company, Ltd., Birkenhead, for installation on a 6,000-ton twin-screw, geared-turbine steamer developing about 2,625 horsepower per shaft. The shaft diameter is 9 inches and the revolutions at full speed 200 per minute. 5 illustrations. 800 words.—*Engineering,* December 18.

The Institute of Marine Engineers.—In describing the new building on Tower Hill of the Institute of Marine Engineers, which was inaugurated by the president of the society in January, the opportunity is taken to discuss the president's address and point out the special services which this institute provides. The institute differs materially from most other technical organizations in Great Britain, as it aims to include in its membership, primarily, sea-going engineers, and, secondarily, engineers whose work may be directly influenced by those responsible for the driving of war and merchant vessels. The intimate association of these two classes of professional men has resulted in much benefit to progress in practical marine engineering. 13 illustrations 2,700 words.—*Engineering,* January 22.

Deck Loads of Timber.—Apprehension regarding the safety of deck loads of timber does not seem to have been dispelled in spite of the official limitation which has been placed upon the height of load allowed for such cargoes during the winter months. The question is discussed from the standpoint of stability and of possible disasters owing to the lack of judgment in placing and securing the deck load. It is concluded that the most important point to realize at the present time is not so much the height of the deck load as the possibility of securing it properly, and it is believed that this phase of the question should form the subject of any regulations which hereafter may have to be issued. The stability of timber carriers cannot be measured by the heights of their deck loads. Its regulation, it is claimed, must conform to a very much wider scheme that will apply to ships of all types and descriptions. 1,000 words.—*The Engineer,* January 8.

Description of the Repair Plant of the U. S. S. Vestal.—By Lieutenant-Commander L. J. Connolly, U. S. N. The *Vestal,* built originally as a collier for the United States navy, has an over-all length of 465 feet 10 inches, an extreme beam of 60 feet 2½ inches, and a normal displacement of 7,720 tons. Propulsion is by two triple-expansion, three-cylinder engines of 7,500 horsepower, and the speed 14 knots, steam being furnished by six Babcock & Wilcox boilers at 180 pounds working pressure. The conversion of the *Vestal* from a collier to a repair ship, authorized by Congress in 1913, required the installation of decks and galleries in the former cargo holds; the relocation of two of the original four masts, the masts being now so placed as to permit the use of traveling cranes in the shops; the installation of additional electric and pneumatic power and distilling apparatus. A number of structural changes were made. Fresh water tanks were built in which to carry water for the larger crew; the superstructure was extended aft to provide for an optical workshop, a general office and a drafting room. Skylights were built to cover the original cargo hatches, and six cargo ports, three on each side, were cut so as to give light and illumination to the workshops and to facilitate the handling of work delivered alongside the boats. A towing engine was installed aft, so that the ship may take another vessel in tow in case of necessity. A detailed description, well illustrated with photographs, is given of the general storekeepers' store, the machine shop, electric shop, coppersmith shop, pattern-making shop, foundry, carpenter's shop, optical shop, etc., together with a description of the equipment installed for giving prompt repairs to vessels away from repair yards. 25 illustrations. 4,700 words.—*Journal of the American Society of Naval Engineers.* February.

Turbine Electric Propulsion of a Battleship Compared with Other Means.—By Lieutenant-Commander P. W. Foote, U. S. N. In a paper by Captain C. W. Dyson, U. S. N., on "Engineering Progress in the United States Navy," which was read before the Society of Naval Architects and Marine Engineers in November, 1913, it was shown that reciprocating engines were more advantageous for use in battleships in the United States navy than the turbine, in the following characteristics: Greater economy in low speeds, hence greater cruising radius; ease of upkeep of machinery, allowing greater readiness for duty; efficient propellers for maneuvering and high backing power; weight and space; minimum vibration of hull, due to machinery, and steadiness of hull as a gun platform. In the following particulars the reciprocating engine and the turbine were shown to be about equal: Economy at maximum speed when this does not exceed 22 knots; reliability when driven at high powers, and boiler weight and space. The only condition in which the turbine was considered superior to the reciprocating engine was in case the necessary power to be developed was greatly increased from that at present, and if the ordinary cruising speed were made considerably higher than now used. The above characteristics showed good reason why reciprocating engines were preferred to turbines for the battleships *New York, Texas* and *Oklahoma.* Now, however, there are two means for which great merit is claimed by which the speed of the turbine may be reduced and the power transmitted to the propeller with a high efficiency. These two means are mechanical reduction gearing and electrical transmission. The author cites the various cases where these two forms of propulsion have been adopted, pointing out the merits and defects developed. In the author's opinion the data and comparisons thus presented show conclusively that for a battleship the turbine electric-propelling machinery completely outclasses not only the reciprocating engine but all other types of machinery now developed for the purpose, the points of superiority being economy at moderate and low speeds, hence great cruising radius; economy at maximum speed, hence ability to run at highest speeds without exhausting the fuel supply or fire-room force if coal is used; great reliability when driven at maximum speed; facility of control, high backing power, efficient propellers; less weight of machinery and space occupied by it; less boiler weight; less work necessary for care and upkeep, allowing greater radius of duty, and lack of racing of propellers, hence greater ability to steam at high speeds in a heavy sea. After a careful consideration of all the engineering features involved in battleship propulsion, the author fails to find any reason why electric drive should not be utilized on the new United States battleships. 7 illustrations. 9,400 words. —*Journal of the American Society of Naval Engineers,* February.

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New Books for the Marine Engineer's Library

New Edition of Seaton and Rounthwaite's Pocketbook of Rules and Tables—Captain Dyson's Chart System for Designing Screw Propellers

MARINE ENGINEERING RULES AND TABLES. Twelfth edition. By A. E. Seaton and H. M. Rounthwaite. Size, 4 by 6¼ inches. Pages, 713. Numerous illustrations. New York, 1914: D. Van Nostrand Company. London, 1914: Charles Griffin & Company, Ltd. Price, $3.50 net.

For over twenty years Seaton and Rounthwaite's Pocketbook of Marine Engineering Rules and Tables has been used by marine engineers throughout the world as a standard reference book for use in the many problems involved in the design, construction and operation of marine machinery. Since the first edition of this Pocketbook was issued in 1893, conditions of ordinary marine engineering have been considerably modified, and the introduction of the turbine and internal combustion engines for the propulsion of ships has added very considerably to the demand for data not included in the early editions of the book. In the present revised and enlarged edition all of the tables have been extended up to and even beyond present practice. The new rules of the Board of Trade, recently issued, and the many modifications of Lloyd's and other registry societies have been embodied. Fresh tables have been added to enable students and others engaged in research work to economize their time. Also much other information not available before will be found generally useful.

The contents of the book include, first, a general treatment of the power and propulsion of ships, giving data on efficiency of marine machinery, engine power measurements, the thermodynamics of steam engineering and the details of reciprocating engines, including data on dimensions, proportions, loads and stresses with details of fittings, etc., for both naval and mercantile practice. This information applies not only to the main engines, shafting and propellers, but also to condensers, pumps, valve gears, valves and auxiliaries. Separate sections deal with steam turbines and internal combustion engines. A considerable portion of the book deals with boilers, giving data on construction, requirements, proportions, efficiency and boiler work. Materials, strength of materials, composition, properties and costs of various metals and numerous other subjects are included. In all, nearly 200 tables are published in the book.

SCREW PROPELLERS AND ESTIMATION OF POWER FOR PROPULSION OF SHIPS. By Captain Charles W. Dyson, U. S. N. Vol. I—Text. Size, 5¾ by 9 inches. Pages, 142. Illustrations, 24. Vol. II—Atlas. Size, 9¾ by 15½ inches. Charts, 32. New York, 1913: John Wiley & Sons, Inc. London, 1913: Chapman & Hall, Ltd. Price, $7.50, 31/6 net.

For many years Captain Dyson has been associated with that branch of the work of the Bureau of Steam Engineering of the United States Navy which has to do with the design of propellers for naval vessels. His work in this direction has given him exceptional opportunities not only to carry out the design and follow out the performance of screw propellers for many different types of vessels but also to have access to a vast amount of data on propellers not readily available to the layman. His study of the subject began in 1901, when at the request of the late Rear Admiral George W. Melville, at that time engineer-in-chief of the navy, he began the preparation of a paper on the performances of the screw propellers of naval vessels. From time to time papers were published giving the results of his investigations until finally the subject matter of the various papers was arranged for publication in book form.

The theory of propeller design that Captain Dyson sets forth is based on model tank trial curves of model hulls supplied by Rear Admiral David W. Taylor, chief constructor of the United States Navy; Froude's theory of the propeller as developed by S. W. Barnaby, and the data of trials of actual vessels as supplied by the Bureau of Steam Engineering. Barnaby's constants for propeller efficiencies are represented graphically on a chart on which can be plotted from their performances the location of any desired propeller. Many propellers were so plotted by Captain Dyson, and from the results were obtained a sufficient number of factors to enable those factors of propeller design, which directly affect the efficiency, to be so tied together graphically as to render it possible to take from these charts, when the resistance and form of hull of the vessel are known, the necessary factor for use in the determination of the diameter, pitch, projected area, and probable propulsive coefficient that will be obtained, for any desired case. The series of charts thus developed offers a most convenient and readily applicable means of designing propellers that give uniformly good results. When basic hull data of sufficient accuracy are at hand this method can be depended upon to give as good, if not better, results than can be obtained by any other method.

Aside from the description of the development of this method of propeller design and of the use of the charts, the contents of the book cover such subjects as the estimation of power for propulsion, form of blades and blade sections, materials for propellers, the effect caused on performances of propellers by varying the elements of the propellers, cavitation, etc. Problems met with in propeller design are also given, together with forms for computation and a chapter, prepared by Luther D. Lovekin, on the geometry and drafting of propellers. The author is to be congratulated upon the splendid presentation of the subject. The book will be found of inestimable value by all who have to do with the design of screw propellers and the powering of ships.

HANDBOOK OF TECHNICAL INSTRUCTION FOR WIRELESS TELEGRAPHISTS. By J. C. Hawkhead. Size, 5½ by 8½ inches. Pages, 295. Illustrations, 170. London, 1913: The Marconi Press Agency, Ltd. Price, 3/6 net.

This course of instruction has been arranged so that the diligent reader who has gone carefully through it might be qualified to sit for the Postmaster-General's examination for wireless telegraphists. The author has had a practical experience in the operation and construction of all classes of wireless apparatus and stations and the text-book embodies this experience. It will be found very useful to beginners in the science of wireless telegraphy.

WHALE FISHERY OF NEW ENGLAND is the title of a 63-page, paper-bound book issued by the State Street Trust Company, Boston, Mass.

No chapter in American history is more fascinating than the story of the early whaleman, and even the novice cannot read this exceedingly interesting book without realizing this. The story is well told and the illustrations are exceptionally fine, there being forty-two of them, nearly all of which are reproductions of rare old prints. The story is told in such a way that everyone who reads it will not only enjoy it but benefit by it.

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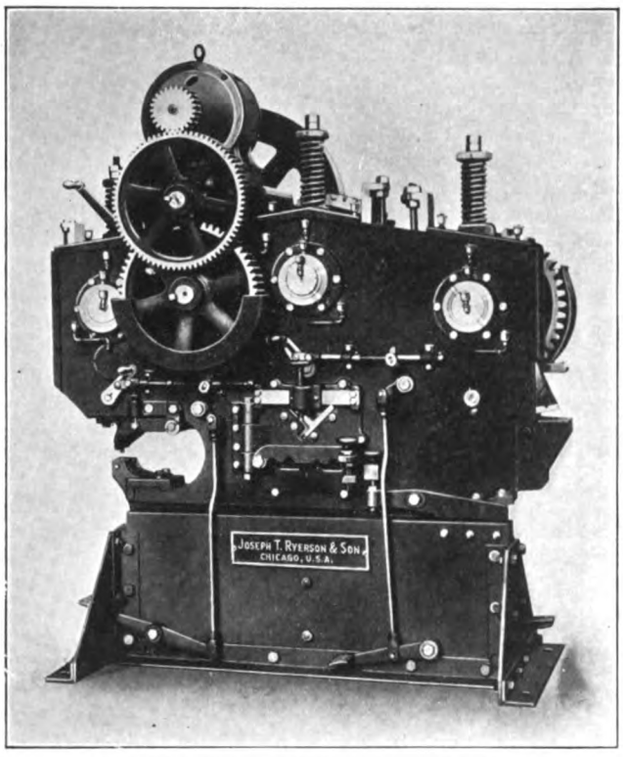
ENGINEERING SPECIALTIES

Ryerson Quintuple Combination Punching and Shearing Machine

The quintuple combination punching and shearing machine illustrated, which has just been placed on the market by Joseph T. Ryerson & Son, Chicago, embodies five metal working machines in one, handling the punching, shearing, coping and notching work on plates, bars, angles, tees, beams and channels without the necessity of interchanging any attachments for the various operations. The



Five Metal Working Machines Embodied in One

punch or bar cutter and splitting shear can be operated independently by automatic clutches which can be thrown in either by hand or by foot levers.

The frame of the plate shear consists of a solid steel offset shear body which permits the cutting of plates of any width or length. A hold-down which can be adjusted vertically and horizontally is provided with the splitting shear.

By an important arrangement of the bar-cutting device, angles, tees and round and square bars can be cut without any change of shear blades. The particular blade for shearing angles and tee-bars is of right angle shape which, it is claimed, produces a perfect cut without bending even the smallest and lightest sections. The shear blades are fastened to the slide in a simple manner, and are made in four pieces instead of one. Stationary blades are mounted on a hinged steel frame which enables the easy removal and grinding for any part of the shearing blades. Adjustable hold-downs permit the cutting of various materials to a perfect right angle and a special arrangement is furnished with the machine which allows the cutting of angles in miter up to 45 degrees.

The punching machine is equipped with a standard architectural jaw permitting the punching of I-beams, channels and similar sections in flange and web. A patented centering device is furnished with each machine, allowing the centering of the punch to the full length of the stroke of the plunger. A universal hold-down takes care of stripping any material to be punched.

In the coping and notching machine the heavy head of the splitting shear is provided with an extension to receive the die block for coping and notching work. This die block is of rectangular shape, permitting not only the standard coping of light I-beams and channels, but also the notching of angles, tees, Z-bars and other shapes.

The combination machine is equipped with steel gears with cut teeth throughout and can be furnished either for belt or motor drive. All gears are well covered with cast guards so as to insure safety and to conform to state laws for the protection of workmen. The machine is manufactured in four different sizes, the smallest weighing 3,000 pounds and requiring from 2 to 3 horsepower for operation, and the largest weighing 25,000 pounds and requiring 10 to 15 horsepower for operation.

Universal Line of Life Preservers

The demand for increased safety at sea has resulted in not only bringing out improvements in the structure of vessels and lifeboats, but also in drawing attention to the great need for more efficient life preservers. The life preserver is the last resort between the vessel and possible drowning when a vessel sinks and when the disaster is sudden the preserver is sometimes the only chance for saving life. Lord Mersey's investigation into the loss of the *Empress of Ireland* brought out the fact that many lives that should in all reason have been saved were lost through the inefficiency of the ordinary life belts, in that the head of the wearer was permitted to fall into the

Universal Ilanasilk Mattress Used as a Raft

water before the persons were picked up by the rescuing boats. The rescuers expected to find live people, but were astounded to find the bodies hanging limply in life belts with heads submerged and bodies well above the surface. Since Lord Mersey's return to London, the subject of providing more efficient life preservers has been continually before the marine officers of the Board of Trade. On January 8 the Universal type of life preservers used in the U. S. Navy and invented by Lieut. S. P. Edmonds, U. S. Coast Guard, retired, was officially adopted by the British Board of Trade, after presentation by Messrs. Cox, McCuen & Co., Baltic House, London.

These life preservers are filled with Ilanasilk, manu-

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factured from prime Java Kapok with special processes by the Robinson-Roders Company, of Newark, N. J., and are now used extensively by the United States Navy, the United States Coast Guard and other marine services. The United States Steamboat Inspection Service also has them under consideration for approval. The Universal

Universal Ilanasilk Mattresses, Pillows and Life Preservers in Action

Life Line includes life preserver pillows which are excellent for the bunks, as well as most efficient life preservers; ship life preservers that can be stored in the same spaces as present cork life belts; life-saving mattresses which are most comfortable and sanitary and may be quickly joined into rafts of any size; boat cushions, art fancy cushions, etc. Each is provided with an inspector's tag showing its recognized use as life preserver.

The underlying principle of these life preservers is their efficiency in holding the wearer's head out of water even when exhausted or unconscious, thus overcoming the fatal defect of preservers otherwise designed. Ilanasilk is the result of many years of development under patented processes. By careful tests the quality is maintained at the high degree necessary for reliable and efficient life preservers.

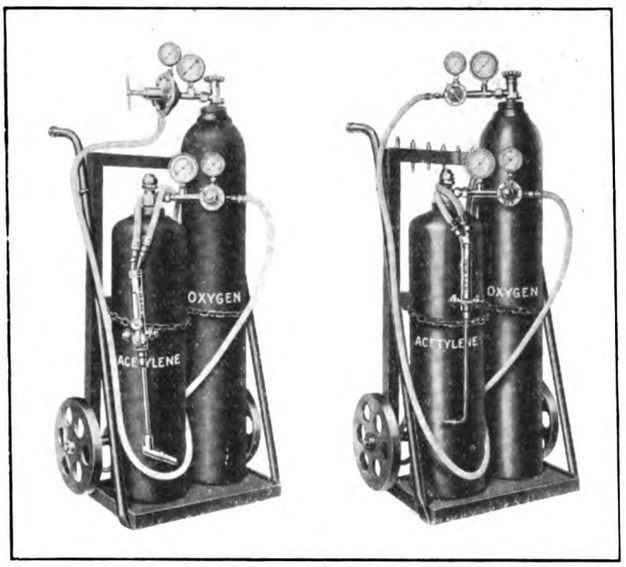
The Robinson-Roders Company was recently awarded the Exposition Gold Medal of the International Exposition of Safety at the Grand Central Palace, New York, for the development of Ilanasilk and the manufacture of Universal Life Saving Equipments. Lieut. Edmonds was awarded the Special Gold Medal at the same time. The company has also received the award of a medal by the American Institute of New York City.

Imperial Oxy-Acetylene Equipment

Oxy-acetylene welding and cutting equipment, possessing some new exclusive features, has recently been placed on the market by the Imperial Brass Manufacturing Company, 1204 West Harrison street, Chicago, Ill. For the safe, efficient, economical and continuous operation of oxy-acetylene equipment two vital points are necessary, namely: (1) Thorough and uniform mixing of the two gases employed, and (2) close and accurate regulation of both volume and velocity of the gases delivered to the mixing chamber of the torch, and ability to maintain a sudden fixed pressure under continuous operating conditions, as well as to control a wide range of pressures called for by the various requirements of service. These features, it is claimed, have been attained in "Imperial" welding and cutting equipment.

A new principle is used for mixing the oxygen with the acetylene. Before entering the mixing chamber of the torch the oxygen under high velocity passes through a spiral groove which imparts to it a whirling motion. The whirling motion of the oxygen, it is claimed, causes it to mix thoroughly with the acetylene, with the result that a uniform mixture is obtained before the gases reach the combustion point. In this way a saving of oxygen is obtained, together with an increased intensity of the welding flame and greater efficiency in cutting.

"Imperial" welding and cutting torches are fitted with interchangeable tips to cover all ranges of work within the limits of the process. The needle valves permit a fine



Cutting Equipment Welding Equipment

adjustment and are located so that the operator can make any desired adjustment of the flame with the hand that holds the torch, making it unnecessary to lay aside the welding stick. Due to the thorough mixing and accurate regulation of the gases, the welding flame generated is a long, white, incandescent jet free from carbons and oxides. The cutting flame is a very closely confined and accurately proportioned jet designed to make a clean, quick, narrow cut with a minimum consumption of gas.

"Imperial" regulators, it is claimed, deliver an absolutely constant pre-determined volume and velocity of gas

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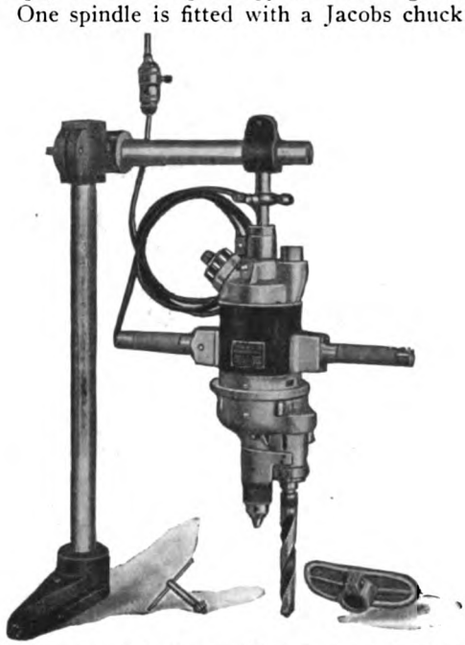
to the torch and the movement of the valve with relation to the valve seat is limited in such a way as to prevent cutting of the seat, thus insuring long life. In cutting operations under high-pressure "Imperial" regulators will automatically shut off in an emergency.

Stow Two-Spindle Drill

The Stow Manufacturing Company, Binghamton, N. Y., has placed on the market a two-spindle drill particularly adapted to heavy work such as would be required in machine shops, railroad shops, shipyards and large industrial plants. One spindle is fitted with a Jacobs chuck taking



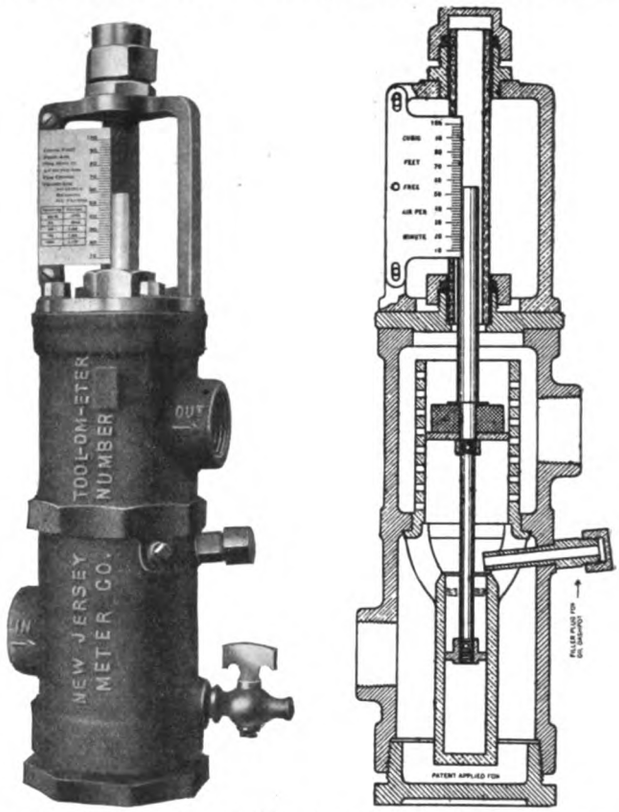
S. S. drills up to ½ inch, running at a speed of 450 revolutions per minute. The second spindle takes M. T. drills up to ¾ inch, operating at a speed of 225 revolutions per minute. The drill is furnished complete with a breast plate and screw feed and will drill holes up to a 1-inch diameter in cast iron.

This tool is claimed to be the only two-speed, two-spindle drill on the market, and among the special advantages claimed for it are greater power for heavy drilling from the large spindle and the ease with which either spindle can be reversed, which will be found a great advantage in light tapping, etc. The tool is operated by electricity and, as shown by the illustration, can be readily attached to an ordinary socket.

The Tool-Om-Eter

The Tool-Om-Eter, which has just been placed on the market by the New Jersey Meter Company, Plainfield, N. J., is an instrument for the measurement of air used by pneumatic tools. The meter is so constructed that it shows direct on a scale in cubic feet of free air per minute the flow of air in a pipe or hose. Reference to the sectional drawing will show that there is only one moving element consisting of a weighted piston in the upper or metering cylinder, a small piston in the oil dash-pot cylinder and a rod joining the two pistons and extending upward, where it moves freely without contact inside the sight glass at the top of the meter. This moving element floats on air and is, consequently, frictionless and non-wearing. The rod rises and falls with the pistons, so that its height in the sight glass corresponds exactly to the position of the piston in the metering cylinder. The scale plate mounted against the outside of the sight glass permits reading the exact height of the top end of the rod.

The meter operates in accordance with the well-known law that the volume of a definite compressed fluid, or gas, flowing under small constant head through multiple orifices of the same shape and size is directly proportional to the number of orifices exposed to the flow. It can be seen from the sectional drawing that the air enters at the lower left-hand opening into the chamber surrounding the dash-pot cylinder and passes through ported openings into the interior of the meter cylinder, the wall of which is drilled with a large number of small, accurately reamed holes uniformly spaced. To pass to the



outlet chamber the air lifts the piston and exposes some of these holes to the flow. A small head, or difference of pressure, is established between the interior of the cylinder and the outlet chamber, the pressure difference amounting to only a few ounces per square inch, being fixed by the exact weight of the moving elements and the area of the piston on which the difference of pressure acts. The moving element rises until the weight is exactly supported by the difference in pressure. The pistons and rod are then floating in static balance in a position corresponding exactly to the volume of air flowing, the number of holes exposed and the height of the top of the rod in the sight glass.

An accurate and easily handled instrument of this sort is especially useful for comparing the economy of different makes of compressed air tools and for maintaining efficiency at a maximum by knowing how much air such tools take when new and after use, and before and after repairing, adjusting or putting in new parts. While practical men can judge the work performed by pneumatic tools, they are unable to judge when the air consumption of individual tools is excessive. A tool may work fairly well, even though the rated air consumption may be exceeded 100 percent or more. The Tool-Om-Eter, it is claimed, will detect and measure any leakage in air lines.

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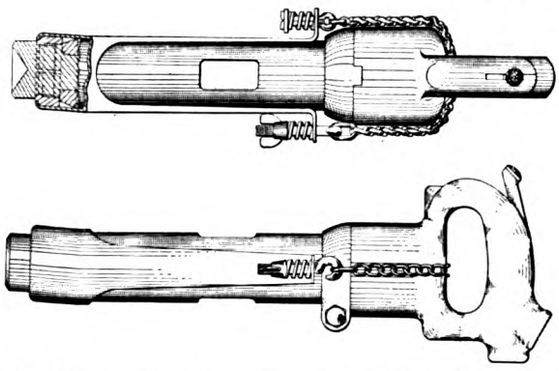
valves, hose, cocks, etc., and determine the net volume of actual air produced by compressors for comparison with a nominal rating or displacement, and, therefore, show whether the machines are operating efficiently or not.

These meters are manufactured in two sizes, one known as the Tool-Om-Eter, of 10 to 100 feet capacity with 1-inch openings, which is recommended for most small tools, such as chipping and riveting hammers and drills, rated by manufacturers at not over 60 feet per minute when new, and another size styled the "Drill-Om-Eter," of from 50 to 300 feet capacity with 2-inch openings for large drilling machines, motors, air lifts, compressors, etc.

Safety Rivet Set Retainer

The George Oldham & Son Company of Frankford, Philadelphia, Pa., manufacturers of pneumatic tools and appliances, have recently placed on the market a safety rivet set retainer which is a decided step in advance in



the "Safety First" movement. The details of the device are clearly shown in the illustration. One of the chief advantages claimed for it is its flexibility, as it can be used on a pneumatic hammer of any make. The retainer weighs 2 pounds.

A New Line of Cutting Tool Holders

J. H. Williams & Co., Brooklyn, N. Y., has placed on the market a complete line of metal-cutting tool holders, the distinctive feature of which is a cam lock for holding the cutting tools. This cam lock, shown in Fig. 1, provides a rapid and convenient adjustment and offers many

Fig. 1.—"Agrippa" Cam Locks

distinctive advantages over old-style set-screw fastening types. It is claimed that the cam lock provides an increase of 75 percent in the holding efficiency. A small swing of a wrench, approximately 30 degrees, brings the lock into full and positive engagement from a loose fit and vice versa. Both countersunk and hexagonal nut type of cams are provided. It is obvious that this cam type of lock tends to eliminate the frequent damages that occur from twisting off a set-screw head or other holding device.

The cam lock is applied to a number of different metal-cutting tool holders, a few of which are illustrated on this page. Fig. 2 shows the Williams "Agrippa" turning tool holder furnished with either the countersunk or hexagonal nut cam lock. The cam fastener offers full freedom for operation without removal from the tool post and imposes no obstruction to cutting facilities. Fig. 3 shows the Williams "Agrippa" boring tool holder on which a universal cap affords a means for holding all intermediate size of rounds, hexagonal or octagon rods or bars within the limits of its capacity without the use of bushings, shims or other fillers. Two tightening nuts or screws are

Fig. 2.—Turning Tool Holders

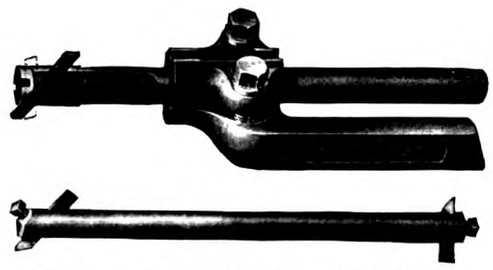


Fig. 3.—Boring Tool Holder and Boring Bar

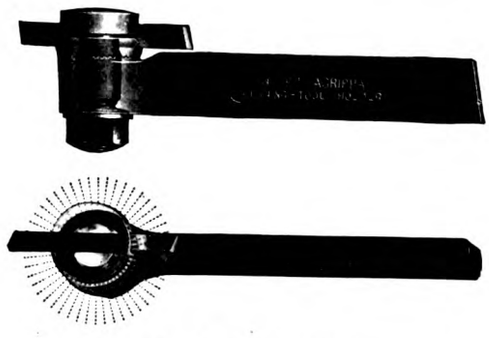


Fig. 4.—Planing Tool Holder

provided to secure greater rigidity and to divide the strain rather than apply it to a single bolt. On the boring bar a universal sleeve is used, making it suitable for either straight or angle cutters without the use of any additional parts.

Fig. 4 shows the Williams "Agrippa" planing tool holder, which has 28 adjustments as compared with seven in the standard tools commonly used. It will be noted that there are 28 rotating serrations corresponding to similar ones in the washer, or adjustment ring. This ring is hardened in order to prevent wearing down of the cutter seat. The locking nut has a hemispherical seat which allows the nut to adjust its seat in line with the strain, thus eliminating side strains in the bolts.

A complete line of cutters is provided for each different holder and for each special purpose.

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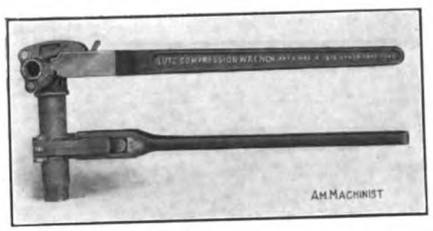
Lutz Compression Wrench

The Lutz compression wrench, manufactured by the Lutz-Webster Engineering Company, Inc., Philadelphia, Pa., is a universal tool which, it is claimed, can be applied to almost any job which confronts the machinist, boiler maker, steam fitter, engineer or manufacturer. Its construction and operation are clearly shown in the illustra-



tion. It is evident that it will be especially useful for driving studs, taps, reamers, drills, etc., and for the adjustment or installation of pump and valve rods, pins, shafts, bolts, pipe fittings and the like.

Manufacturers of the Harris Valveless Diesel Type Engine

The Southwark Foundry & Machine Company, Philadelphia, Pa., manufacturers of steam turbines, electric generators, air compressors, pumps, condensers and hydraulic presses, has secured the exclusive United States license to manufacture the Harris valveless Diesel type oil engine, which was described in our September, 1914, issue, and which will hereafter be known as the Southwark-Harris valveless engine. The engine will be built in sizes from 75 to 1,000 brake horsepower for both marine and stationary service. Leonard B. Harris, the inventor of the engine, will be consulting engineer and naval architect for the company, and J. P. Johnstown will have charge of the oil engine sales.

A Correction

We are informed by the National Tube Company, Pittsburg, Pa., that the statement published on page 140 of our March issue, which reads in part as follows, "The Worth Brothers-Coatesville Rolling Mill Company, Coatesville, Pa., which holds the unique position of being the only tube manufacturer that can supply itself with basic open-hearth steel skelp for tube manufacture . . . ," is incorrect for the reason that the National Tube Company has for a number of years used basic open-hearth steel in the manufacture of boiler tubes, and this material is still used by them for this purpose. They have also used this material for a number of years in the manufacture of both lap-welded boiler tubes and pipe, and also in the manufacture of seamless tubes from ore to the finished product. It should be understood, therefore, that the National Tube Company was the first tube manufacturer to use basic open-hearth steel in the manufacture of boiler tubes, and has continuously used this material up to the present time.

Personal

William Rigney has been appointed assistant engineer of the Southern Pacific steamer *Chalmette*.

P. H. Cox, a well-known marine engineer of Paducah, Ky., has started a "jitney line" of cars at Paducah.

James Cross, of New Orleans, La., has been appointed first assistant engineer on the ocean-going tug *Pan-American*.

F. Gouner, of New Orleans, La., has been appointed second assistant engineer on the ocean-going tug *Charles W. Morse*.

Charles Castle, formerly employed on barge canal work at Fultonville, N. Y., has been appointed chief engineer of the tug *William H. Baldwin*.

James Faas, formerly with the Randerson Dredging Company, has been appointed chief engineer of the Y. M. C. A. building, Albany, N. Y.

Edward Burns, formerly machinist at the U. S. Arsenal at Watervliet, N. Y., has been appointed chief engineer of the New York State tug *Amsterdam*.

E. Perry has been appointed first assistant engineer of the American tank steamer *Louisiana*. J. A. Jones is second assistant engineer of this vessel.

James La Coy has been appointed first assistant engineer of the tug *William H. Kinch*, of the Great Lakes Dredge & Dock Company, Albany, N. Y.

Martin Bronk, of New Baltimore, N. Y., has been engaged as consulting mechanical engineer for the U. S. Government plant at the Troy, N. Y., dam.

Frank Carney, formerly chief engineer of the steam yacht *Chippewa*, of Cedar Hill, N. Y., has resigned his position to enter business at Castleton, N. Y.

Glenville Brown, formerly chief engineer of the tug *Florence*, has been placed in charge of the plant of the Skinner & Arnold Machine Works, Albany, N. Y.

W. J. Chandler, of Paducah, Ky., second mate on the steamer *Alabama*, has been appointed chief mate of the steamer *Bald Eagle*, which recently left Paducah for St. Louis, Mo.

John Knauer, of New Orleans, La., has been appointed chief engineer of the steam schooner *Francis T. Hyde*. Joseph Turner has been appointed assistant engineer on this vessel.

James Hayes, formerly chief engineer of the tug *Lydia* of the Fulton Construction Company, New York, has been appointed chief engineer of U. S. *No. 16* at the Troy, N. Y., dam.

Burton Colvin, formerly chief engineer of the steamer *Augustus Phillips*, which was burned recently at Athens, N. Y., has secured an appointment as chief engineer of the tug *Clinton*.

Charles R. Ziegler has been appointed chief engineer of the hydraulic dredge *Mohawk* engaged in New York State barge canal work. Mr. Ziegler was formerly chief engineer of various Hudson River steamboats.

Charles Jackson, of St. Louis, Mo., has been appointed chief engineer of the river steamer *Kentucky*, which left Paducah, Ky., March 6, to enter the Calhoun County trade out of St. Louis. Eugene Bates is second engineer of this vessel.

Captain R. C. McMahon has succeeded Harry Rodgers as master of the river steamer *Alabama* in Paducah, Ky. Conway Gordon is second mate of the *Alabama*. Harry Rodgers, formerly master of this vessel, is now serving on the steamer *Kentucky*.

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Charles H. Hughes, naval architect and marine engineer, 82 Beaver street, New York, is engaged in compiling a book for shipping men which contains practical data on ship design and construction with sections on marine insurance and chartering.

W. J. G. Hudson, manager of the freight department of the Anchor Steamship Line, was presented with a gold watch on March 13 by the office staff of the line in New York in celebration of his completion of fifty years of service in the company's employ.

Ambrose Van Wie, formerly first assistant engineer of the towboat *William H. Kinch,* has been appointed chief engineer of the towboat *M. A. Knapp,* of the Great Lakes Dredge & Dock Company, Albany, N. Y. Arthur Lamphere is first assistant engineer of the *M. A. Knapp.*

J. L. Western, of Paducah, Ky., has been appointed chief engineer of the Burlington Railroad Company's steamer *North Star,* which left Paducah, Ky., recently bound for Memphis, Tenn., and Kansas City, Mo., where the vessel will be used in the completion of a bridge across the Missouri River. J. W. Hovious, also of Paducah, Ky., is second engineer of the *North Star.*

Morris John Lenney, one of the two warrant officers recently appointed ensigns in the United States Navy, has been ordered to the U. S. S. *Brooklyn* at Boston, Mass. Mr. Lenney was born in Warren, Ohio, on August 3, 1884. He served his apprenticeship in the machine shop of the Peerless Electric Company, of Warren, and was later employed by various machine and engineering companies, finally enlisting in the United States Navy as machinist's mate on September 11, 1905. He won steady promotion, until on December 31, 1908, he was warranted a machinist, in which grade he served three years on board the *Missouri* and two years at the Portsmouth Navy Yard as assistant to the shop superintendent and boiler inspector of that yard. He was commissioned ensign in January of this year, after having served nine years and four months in the Navy.

In its last session Congress passed a bill extending its thanks to and authorizing the promotion of members of the United States Army, Navy and Public Health Service who participated in the construction of the Panama Canal. Colonel George W. Goethals and Surgeon-General William C. Gorgas have been promoted to the rank of Major-General. Colonel H. F. Hodges and Lieutenant-Colonel William L. Sibert have been promoted to the rank of Brigadier-General and Commander H. H. Rousseau, U. S. N., to Captain.

Obituary

J. R. Andrews, president of the Hyde Windlass Company, Bath, Me., one of the most widely known men in the United States among shipbuilders and ship owners, died suddenly of apoplexy March 25 in New York City.

August Mietz, of New York, manufacturer of the Mietz & Weiss oil and gas engines, died recently, aged 80. Mr. Mietz was born in Germany, but came to the United States when he was 21 years old. The firm of Mietz & Weiss was founded about 15 years ago, but recently has been carried on under the name of its founder, August Mietz.

Harrison B. Moore, long identified with harbor transportation in New York City, died at his winter home in Florida on March 4 at the age of seventy-three. Mr. Moore was an enthusiastic yachtsman and was well known in marine circles in the port of New York. After his retirement from active business several years ago, his interests in marine machinery and dry-docking at Erie Basin, Brooklyn, were looked after by his sons Jonathan and Harrison B. Moore, Jr.

Joseph Hallet, chairman of the Council of the Institute of Marine Engineers, died February 9, aged fifty-five years. Mr. Hallet served a five-years' apprenticeship as an engineer in the locomotive and marine department of the London, Brighton & South Coast Railway Works at Brighton, afterward entering the employment of Messrs. J. & G. Renney, where he was engaged in the construction of machinery for important naval vessels. Later Mr. Hallet engaged in business as a consulting marine engineer.

Charles W. Hogan, vice-president of Thomas Hogan & Sons, one of the largest stevedoring firms of New York City, died on March 1 in Provincetown, Bahama Islands, aged fifty-six years. Mr. Hogan was born in Liverpool, coming to the United States when young. After graduating from St. John's School at Manlius, N. Y., he entered the shipping and stevedoring firm founded by his father and continued in that business until his retirement a few years ago. Mr. Hogan was director in a number of large steamship companies.

Frederick Winslow Taylor, famous for his development and application of the science of shop organization and management, and for his invention with Maunsel White, of the Taylor-White high-speed metal-cutting steels, died of pneumonia in Philadelphia on March 21. Mr. Taylor was born in Germantown, Pa., in 1856. In 1878 he entered the employ of the Midvale Steel Company as a laborer and six years later became its chief engineer. In later life, as a consulting engineer, Mr. Taylor's influence in the engineering and industrial world became far-reaching. He was a past president of the American Society of Mechanical Engineers.

George Lawley, of Boston, Mass., head of the famous yacht and shipbuilding firm bearing his name, died February 27, aged ninety-two years. Mr. Lawley was born in London and came to the United States in 1851. Three years later he established a shipyard in East Boston, moving the plant to Scituate, Mass., in 1866. The original South Boston yard was founded in 1874, and it was there that the cup defenders *Puritan* and *Mayflower* and many other famous yachts and sea-going vessels were built. In 1890 the business was incorporated and Mr. Lawley retired from active management.

Charles C. Scott, chairman of Scott's Shipbuilding & Engineering Company, Ltd., Greenock, died February 11 at Halkshill, Largs, Ayrshire, aged forty-eight years. Mr. Scott was educated in the South of England, afterwards studying at Fettes College, Edinburgh, and the Edinburgh University. He served his apprenticeship as an engineer at the Messrs. Scott's Greenock works and was appointed assistant engine-works manager in 1890, becoming assistant general manager in 1900. Upon the death of his father, in 1903, he became one of the managing directors, and in 1905 he was elected chairman of the company. Mr. Scott was past-president of the Clyde Shipbuilders' Association and of the North-West Engineering Trades Employers' Association. He was also a member of the Institution of Naval Architects, of the Institution of Engineers & Shipbuilders in Scotland and of the Committee of the British Corporation for the Survey and Registry of Shipping.

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SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

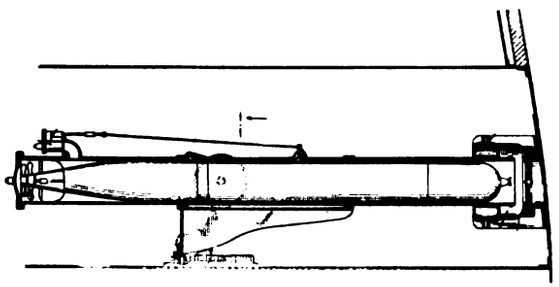
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,110,410. BULKHEAD-DOOR. HORACE H. THAYER, JR., OF WILMINGTON, DEL.

Claim 1.—In a door for partitions, a partition having an opening providing a door-way, two doors closing the door-way and inclosing between them a space, and means connected with said space to regulate the air pressure therein. Ten claims.

1,122,700. APPARATUS FOR LAUNCHING TORPEDOES. GREGORY C. DAVISON, OF QUINCY, MASSACHUSETTS.

Claim 1.—The combination with a ship's hull having an aperture therein below the water line, of a torpedo tube mounted wholly within said hull and for angular movement about a point adjacent said aperture



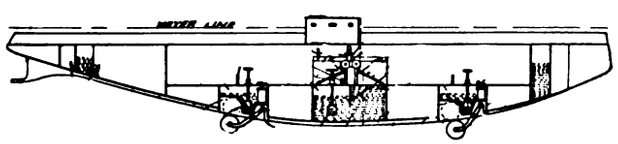
and provided with a yieldable retaining device adapted to be overcome and movement of said tube effected by an issuing torpedo diverted from its course. Four claims.

1,122,782. VESSEL. ALEXANDER McDOUGALL AND ALEXANDER MILLER McDOUGALL, OF DULUTH, MINNESOTA.

Claim 1.—A vessel comprising a hull, vertically removable superstructures at one or both ends of the hull and a depressed working deck supporting means for controlling the vessel whereby said means do not project above the upper deck of the vessel. Twelve claims.

1,123,762. BUOYANCY-REGULATING APPARATUS FOR SUBMARINE BOATS. SIMON LAKE, OF MILFORD, CONN., ASSIGNOR TO LAKE TORPEDO BOAT COMPANY OF MAINE, OF BRIDGEPORT, CONN., A CORPORATION OF MAINE.

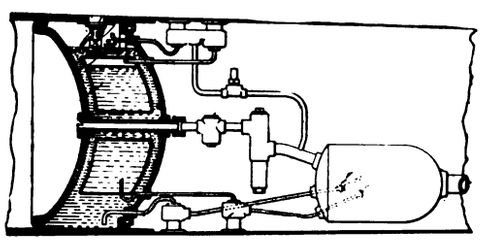
Claim 9.—A submarine or submersible boat, having a central main ballast tank, forward and after ballast tanks, and forward and after trimming tanks, compartments arranged in said main ballast tank in open



communication therewith at their lower ends, one of said compartments having its center of volume arranged in substantially vertical alinement with the centers of gravity and buoyancy of the boat when the boat is on an even keel, means for admitting water ballast to said tanks, and means for excluding water from one of said compartments in the main ballast tank whereby to cause the boat to rise and sink on an even keel. Ten claims.

1,125,979. AUTOMOBILE TORPEDO. WILLIAM DIETER, OF NEW YORK, N. Y., ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF WEST VIRGINIA.

Claim 1.—An automobile torpedo having a compressed air reservoir, a pressure reducer, an air heater, and a liquid tank receiving compressed air, and a liquid tank receiving compressed air and communi-



cating with the air heater, combined with means for excluding sea water from such tank and for venting any leakage of air therefrom, such means adapted to close upon the admission of compressed air thereto. Five claims.

1,116,956. AUTOMATIC MEANS FOR LOWERING LIFE-BOATS. RICHARD TJADER, OF NEW YORK, N. Y.

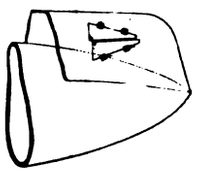
Claim 1.—In automatic means for lowering life-boats, the combination with stationary standards, base and bracing means for said standards, a pair of davit arms including elliptical supports adapted to roll upon said base members, each of said arms constituting a straight extension of a radial edge of its curved support, means to support a boat normally upon the upper ends of said arms, the arms and their supports being so arranged as to be held normally in unstable position whereby when the boat is released the arms will swing outwardly and downwardly automatically, and means to secure the boat keel in normal fixed position. Nine claims.

1,118,257. METHOD AND MEANS FOR AUTOMATICALLY APPLYING DIFFERENTIAL AIR PRESSURE TO COMPARTMENTS OF SHIPS. FRANK JULIAN SPRAGUE AND FRANK DESMOND SPRAGUE, OF NEW YORK, N. Y.

Claim 1.—The combination with the fluid tight compartments of a vessel, of means for supplying compressed air to the several compartments, and reversibly operative means capable of effecting automatic differentiation of the air pressures therein in accordance with their respective distances from an injured compartment. Thirty-five claims.

1,125,567. DIVING-RUDDER FOR SUBMARINE VESSELS. CESARE LAURENTI, OF SPEZIA, ITALY, ASSIGNOR TO SOCIETA FIAT SAN GIORGIO, OF SPEZIA, ITALY.

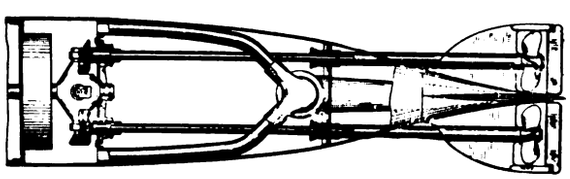
Claim 4.—A boat having depth controlling rudders on each side thereof, said rudders being arranged in pairs on each side of the hull and having axes of rotation substantially in the plane of the side of the hull, and adapted to lie flat against the same, one rudder in each pair



having its axis of rotation upwardly inclined and the other rudder in each pair having its axis of rotation downwardly inclined, whereby, when extended, said rudders present oppositely inclined planes to the water, and means for operating said rudders, said means being adapted to turn together rudders on both sides of the boat having similar inclination of their axes of rotation. Five claims.

1,126,183. TURBINE-DRIVEN TORPEDO. GREGORY CALDWELL DAVISON, OF NEW LONDON, CONN., ASSIGNOR TO ELECTRIC BOAT COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

Claim 1.—In an automobile torpedo, the combination of oppositely revolving turbine rotors arranged in tandem, oppositely revolving propeller shafts arranged symmetrically on opposite sides of the axis of



the torpedo, and intermeshing reduction gearing having kinetic symmetry and arranged to establish diving connection between said rotors and said shafts and maintain synchronous rotation of said shafts. Seven claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

24,379/1913. IMPROVEMENTS IN LIFE SAVING AND SALVAGE APPLICATION ON SHIPS. L. TABULO, 22 VALMAR ROAD, DENMARK HILL, LONDON.

Apparatus for transferring persons and goods from one ship to another, or from ship to shore, consists in the combination of a traveler, hauling ropes attached to said traveler, a cableway for said traveler spanning the distance between the transferring vessel and the receiving vessel and kept taut by means of a weight attached to one or both of its ends passed overboard. A hoisting and lowering apparatus provided on said traveler by means of which the persons to be saved can be raised from the deck of the transferring vessel to a position immediately below the traveler and subsequently lowered at the further end of the cabling to the receiving vessel.

23,514/1913. AN IMPROVED "AHEAD" OR "ASTERN" INDICATOR FOR MARINE ENGINES. C. EDINGTON, 34 MUNRO ROAD, JORDANHILL, GLASGOW.

The invention consists in an electrically operated engine indicator having two pointers, one to indicate "ahead" and the other "astern" connected, respectively, by a wheel and cord arrangement to, and directly actuated by, the coves of two solenoids, one or the other of which is energized according as the reversing engine or gear is operated to cause the engine to go ahead or astern. If it is desired to indicate the engine speed, or the revolutions, the one or the other solenoid is intermittently energized, by means of a make-and-break arrangement, to cause the one or the other pointer, according to the position of the reversing engine on gear, to vibrate synchronously with the movements of a moving part of the engine or the propeller shaft.

6,303/1914. IMPROVEMENTS IN APPARATUS FOR INDICATING THE QUANTITY OF WATER IN THE HOLD OF SHIPS, TANKS OF FLOATING DOCKS AND ELSEWHERE. R. G. WEYLL, OF RUA LAURINDO RABELLO, 73 RIO DE JANEIRO, BRAZIL.

According to the invention, the readings are automatically taken from a voltmeter or other indicating apparatus controlled by the electrical part of a transmitting apparatus comprising a balanced float which operates through a chain and sprocket wheel, a screwed spindle carrying the contact maker connecting with a contact rod and with the insulated terminals of a series of resistances, a current generator being included in the circuit.

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